US009469093B2

(12) **United States Patent**
Wada et al.

(10) **Patent No.: US 9,469,093 B2**
(45) **Date of Patent: Oct. 18, 2016**

(54) **BONDING APPARATUS, BONDING SYSTEM AND BONDING METHOD**

(71) Applicant: **Tokyo Electron Limited**, Tokyo (JP)

(72) Inventors: **Norio Wada**, Kumamoto (JP); **Goro Furutani**, Kumamoto (JP); **Satoshi Ookawa**, Kumamoto (JP)

(73) Assignee: **Tokyo Electron Limited**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 204 days.

(21) Appl. No.: **14/249,842**

(22) Filed: **Apr. 10, 2014**

(65) **Prior Publication Data**

US 2014/0318680 A1 Oct. 30, 2014

(30) **Foreign Application Priority Data**

Apr. 25, 2013 (JP) 2013-092912

(51) **Int. Cl.**

H01L 21/67	(2006.01)
B32B 37/10	(2006.01)
B32B 38/18	(2006.01)
B32B 38/00	(2006.01)

(52) **U.S. Cl.**

CPC ***B32B 38/1858*** (2013.01); ***B32B 37/10*** (2013.01); ***B32B 38/004*** (2013.01); ***H01L 21/67092*** (2013.01); *B32B 2457/14* (2013.01); *Y10T 156/10* (2015.01); *Y10T 156/1744* (2015.01)

(58) **Field of Classification Search**

CPC Y10T 156/10; Y10T 156/17; Y10T 156/1702; Y10T 156/1744; B32B 37/10; B32B 37/1018; B32B 2457/14; B32B 38/004; B32B 38/1858; H01L 21/67092; H01L 21/68; H01L 21/683–21/6835; H01L 21/6838

USPC 156/228, 580, 583.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,921,895	B2 *	4/2011	Shim	H01L 21/67092 156/247
2009/0114350	A1 *	5/2009	Kim	G02F 1/1303 156/556
2013/0062013	A1 *	3/2013	Okada	H01L 21/67092 156/322

FOREIGN PATENT DOCUMENTS

JP	11-145264	5/1999
JP	2008-294099	12/2008
JP	2011-119293 A	6/2011
WO	2010-055730 A	5/2010

* cited by examiner

Primary Examiner — Carson Gross

(74) *Attorney, Agent, or Firm* — Abelman, Frayne & Schwab

(57) **ABSTRACT**

A bonding apparatus according to an exemplary embodiment of the present disclosure includes a first holding unit, a second holding unit, a pressing mechanism and a holding mechanism. The first holding unit is provided with a first heating mechanism and holds a first substrate. The second holding unit disposed facing the first holding unit and provided with a second heating mechanism, holds a second substrate. The pressing mechanism relatively moves the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate. The holding mechanism elastically holds an outer periphery of the first holding unit and the second holding unit.

9 Claims, 11 Drawing Sheets

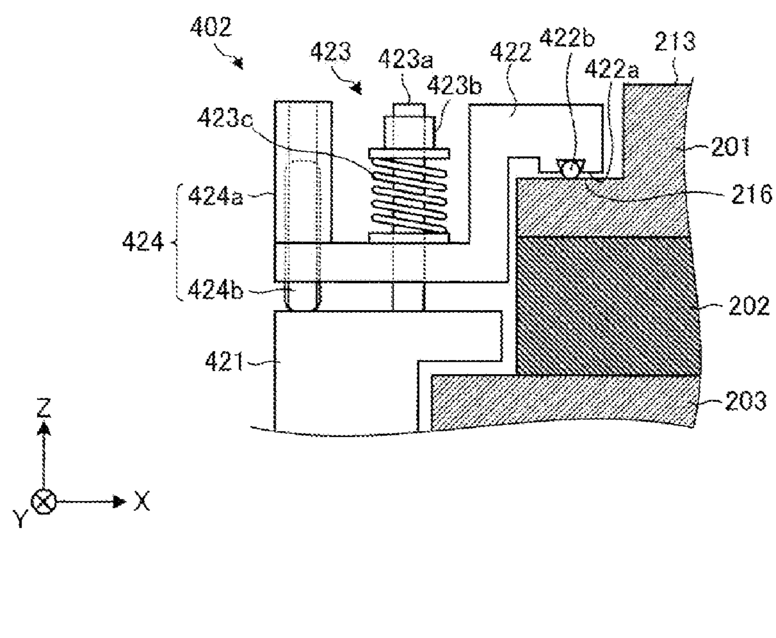
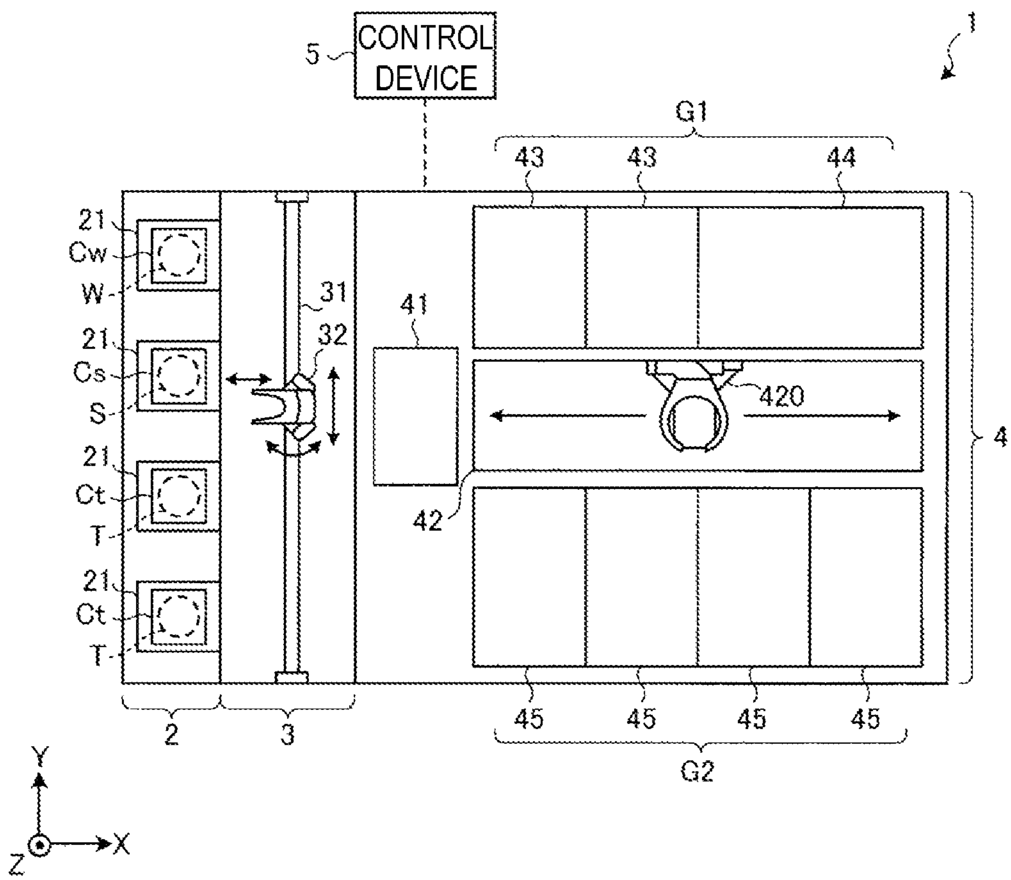
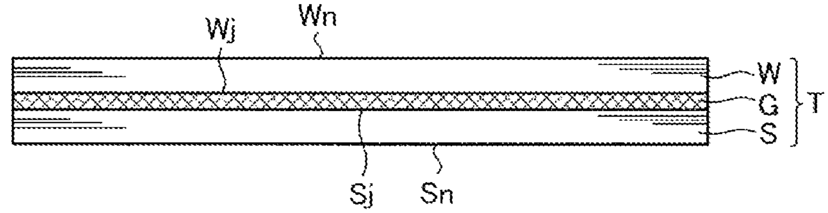


FIG. 1



CONTROL DEVICE
5
1
G1
43
43
44
21
Cw
W
31
41
32
21
Cs
S
420
4
21
Ct
T
42
21
Ct
T
45
45
45
45
2
3
G2
Y
X
Z

FIG. 2



Wj
Wn
W
G
T
S
Sj
Sn

FIG. 3

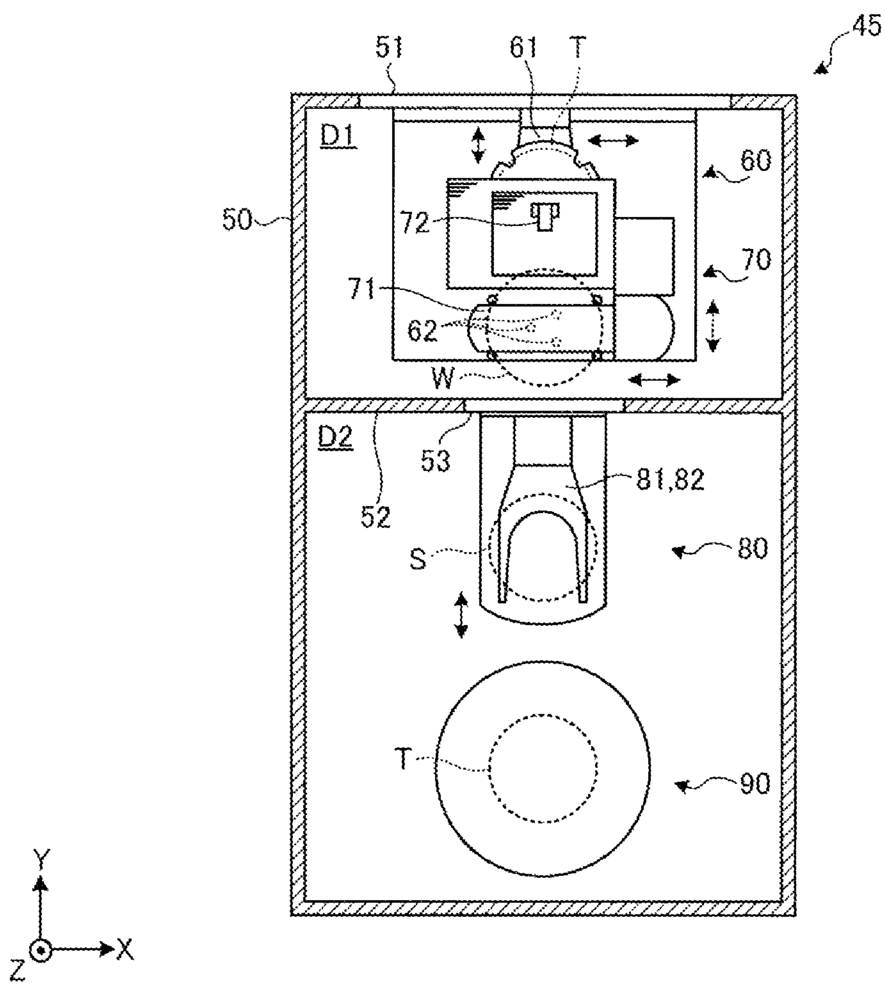


FIG. 4

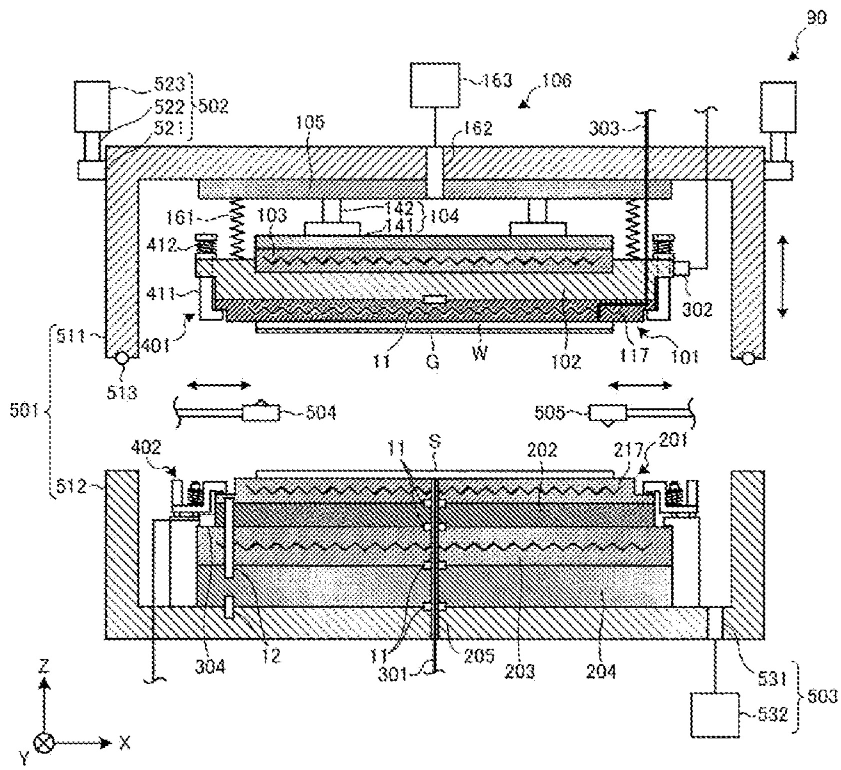

90
523
522
521
502
163
106
105
162
303
142
141
104
161
103
412
411
302
401
511
11
G
W
102
117
101
513
501
504
505
402
S
202
217
201
512
304
12
205
203
204
301
531
503
532
Z
X
Y

FIG. 5A

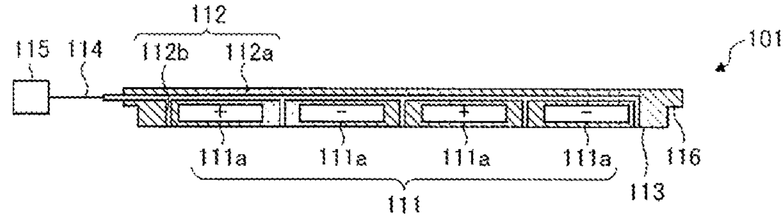

112
115
114
112b
112a
101
+
−
+
−
111a
111a
111a
111a
116
113
111

FIG. 5B

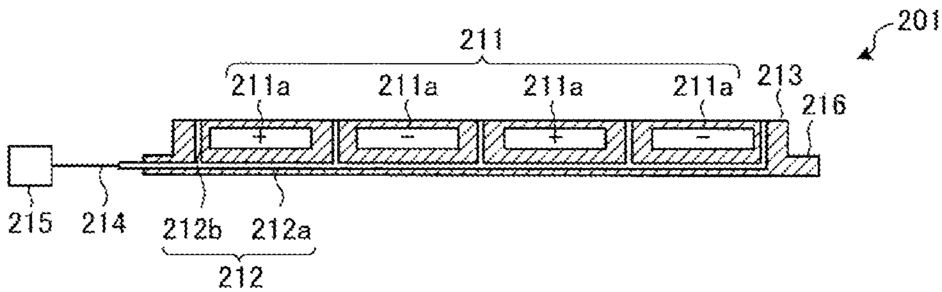

201
211
211a
211a
211a
211a
213
216
215
214
212b
212a
212

FIG. 6A

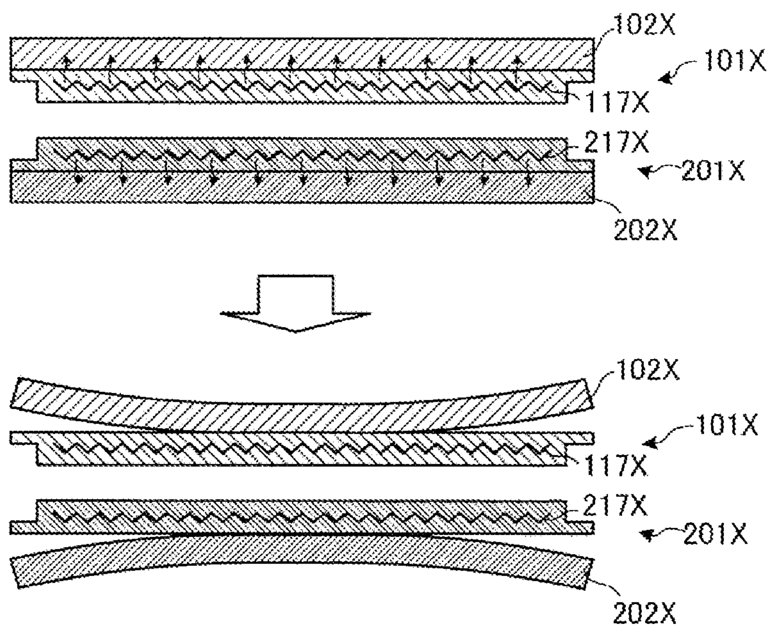

102X
101X
117X
217X
201X
202X
102X
101X
117X
217X
201X
202X

FIG. 6B

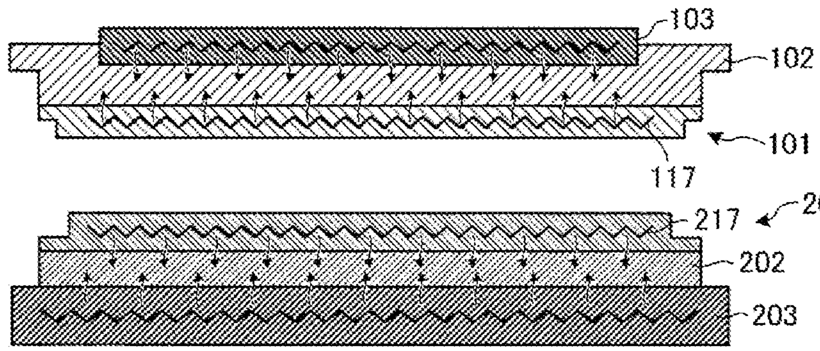

103
102
101
117
217
201
202
203

FIG. 7

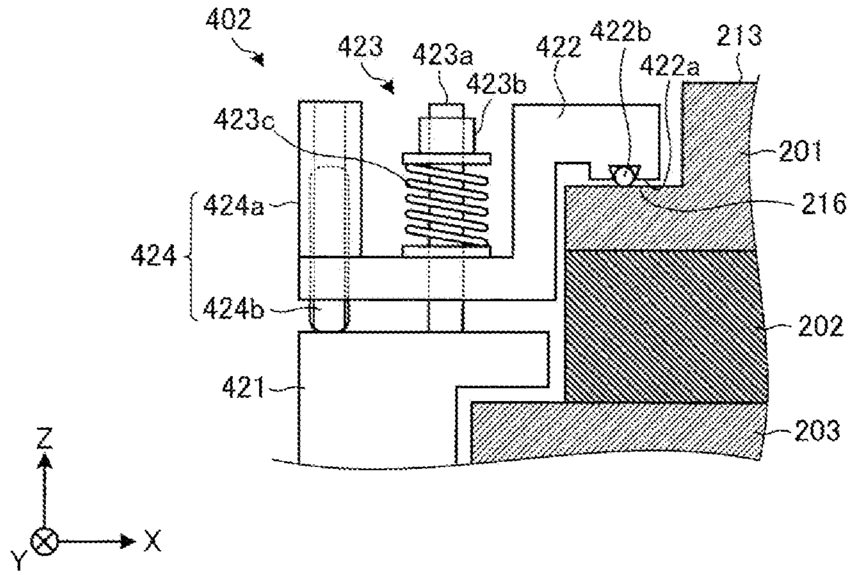

402
423
423a
423b
422
422b
422a
213
423c
201
216
424a
424
424b
202
421
203
Z
Y
X

FIG. 8

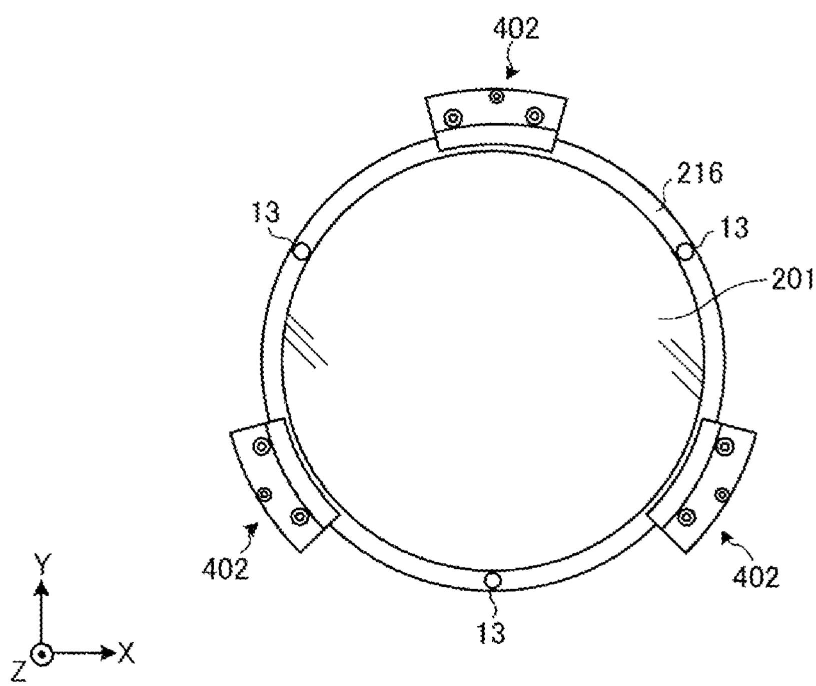


FIG. 9

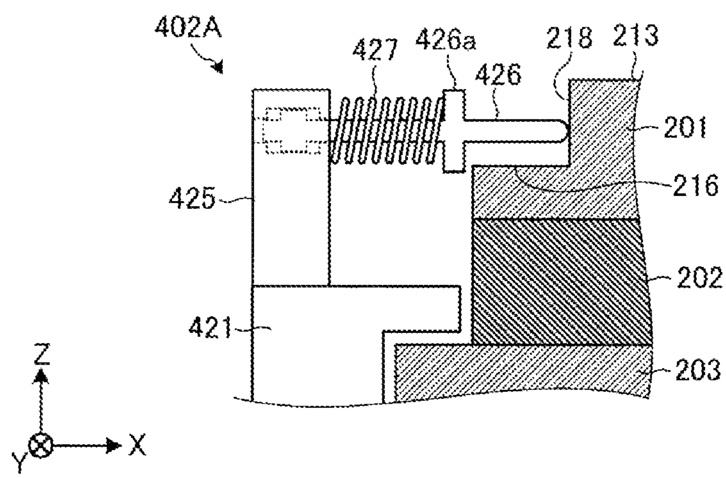


FIG. 10A

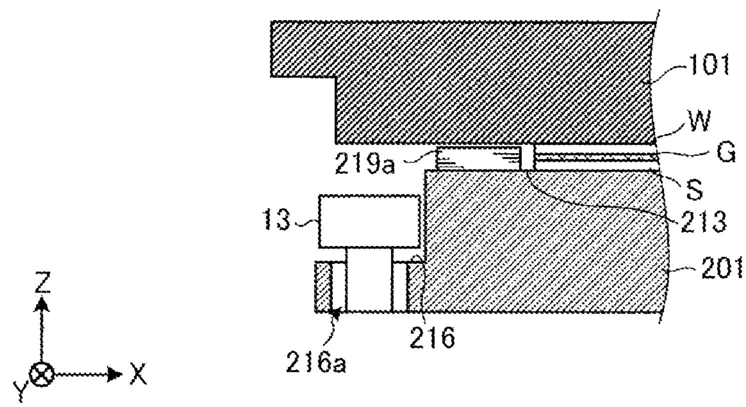


FIG. 10B

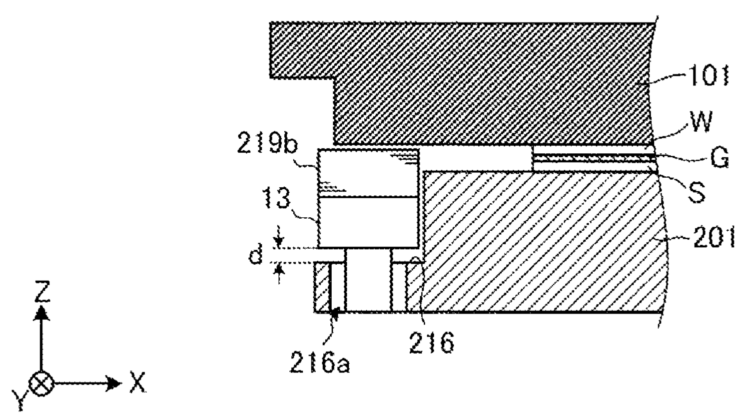


FIG. 11A

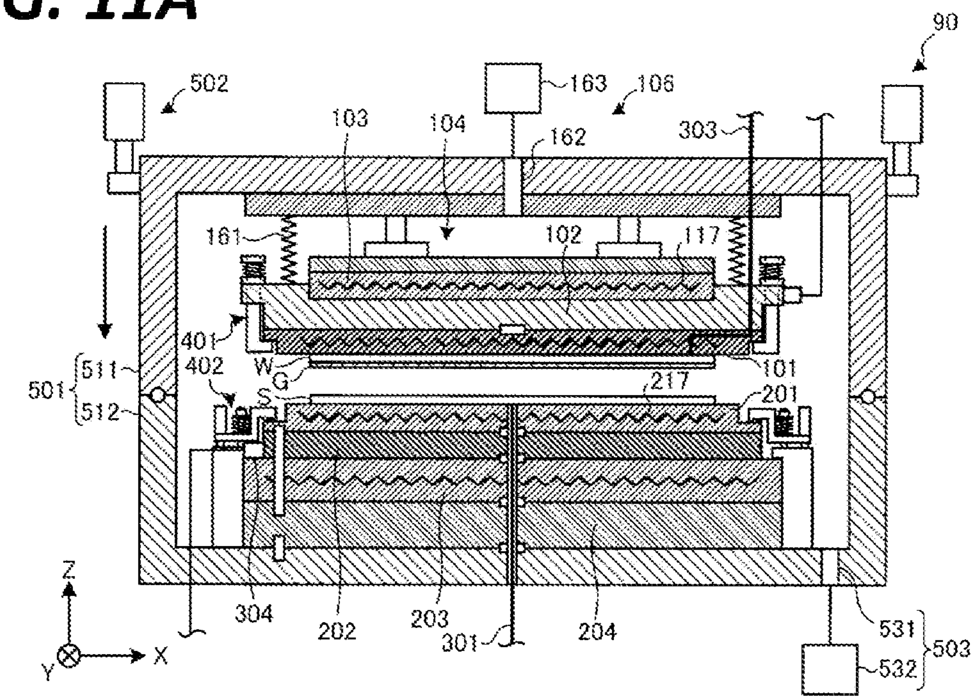


FIG. 11B

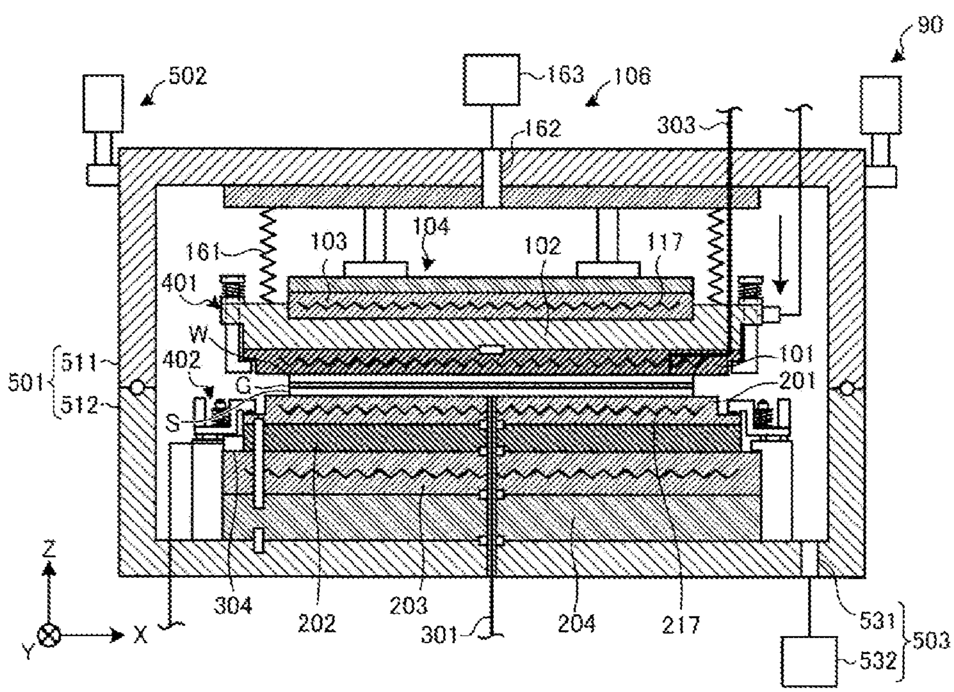


FIG. 12

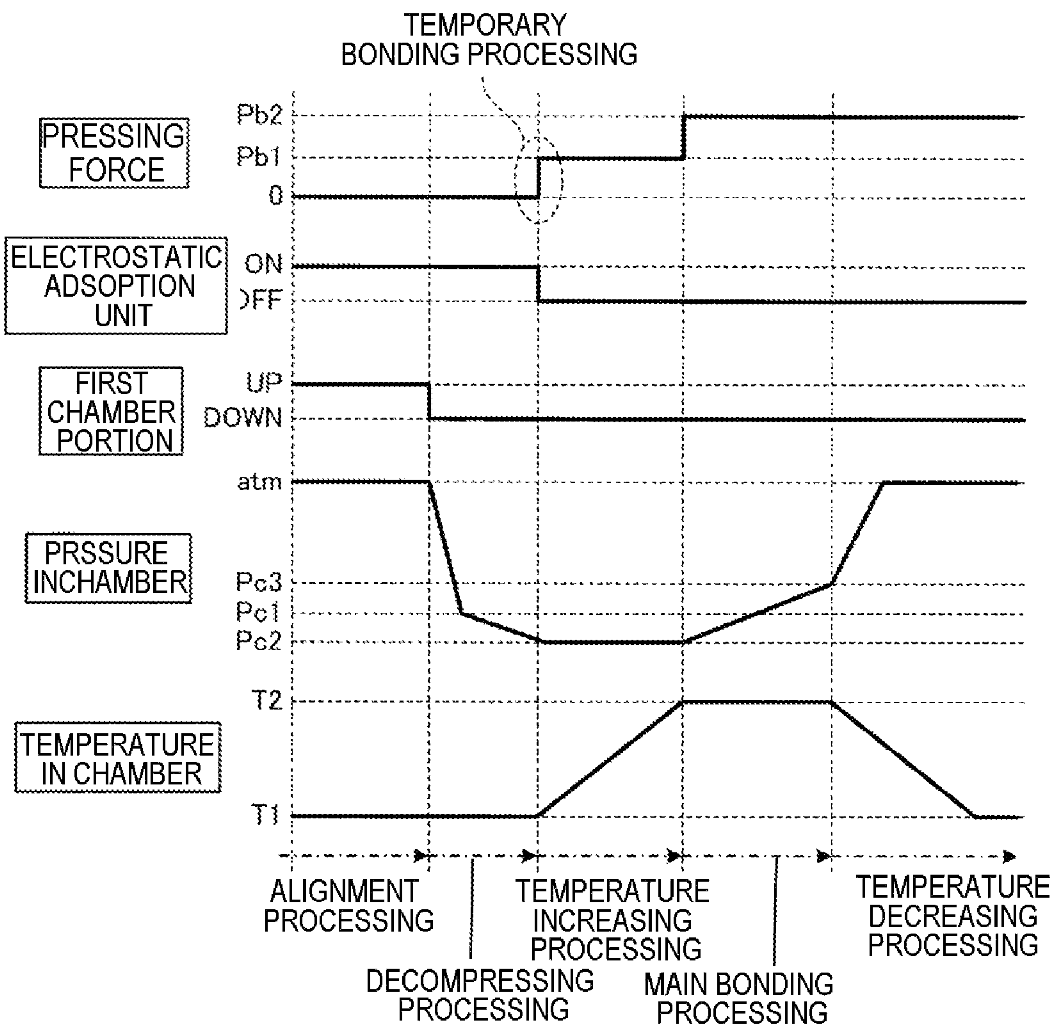
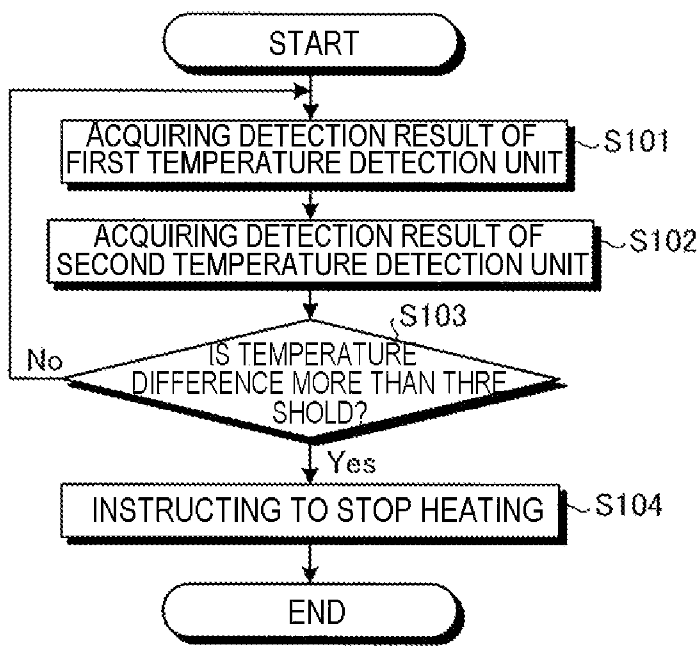

TEMPORARY
BONDING PROCESSING
PRESSING
FORCE
Pb2
Pb1
0
ELECTROSTATIC
ADSOPTION
UNIT
ON
OFF
FIRST
CHAMBER
PORTION
UP
DOWN
PRSSURE
INCHAMBER
atm
Pc3
Pc1
Pc2
TEMPERATURE
IN CHAMBER
T2
T1
ALIGNMENT
PROCESSING
DECOMPRESSING
PROCESSING
TEMPERATURE
INCREASING
PROCESSING
MAIN BONDING
PROCESSING
TEMPERATURE
DECREASING
PROCESSING

FIG. 13


START
ACQUIRING DETECTION RESULT OF FIRST TEMPERATURE DETECTION UNIT
S101
ACQUIRING DETECTION RESULT OF SECOND TEMPERATURE DETECTION UNIT
S102
S103
IS TEMPERATURE DIFFERENCE MORE THAN THRE SHOLD?
No
Yes
INSTRUCTING TO STOP HEATING
S104
END

BONDING APPARATUS, BONDING SYSTEM AND BONDING METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority from Japanese Patent Application No. 2013-092912, filed on Apr. 25, 2013 with the Japan Patent Office, the disclosures of which is incorporated herein in its entirety by reference.

TECHNICAL FIELD

The present disclosure relates to a bonding apparatus, a bonding system and a bonding method.

BACKGROUND

In a manufacturing process of a semiconductor device, semiconductor substrates such as silicon wafers or compound semiconductor substrates have become larger in diameter and thinner in thickness. When a thin semiconductor substrate with a large diameter is transferred or subjected to a polishing process, there is a concern that a warpage or a crack may occur in the substrate. Therefore, target substrates have been reinforced by bonding support substrates such as glass substrates to the target substrates.

For example, International Publication WO2010/055730 discloses a method for bonding a target substrate and a support substrate in which the target substrate and the support substrate are held by an upper chuck and a lower chuck, respectively, and the upper chuck and the lower chuck are brought into close proximity with each other to press the target substrate and the support substrate. An adhesive is then applied on the surface of the target substrate or the support substrate such that both of the substrates are bonded by being pressed as described above.

Further, International Publication WO2010/055730 discloses a method for bonding a target substrate and a support substrate in which heating mechanisms are provided in an upper chuck and a lower chuck and the target substrate and the support substrate are heated.

SUMMARY

A bonding apparatus according to an exemplary embodiment of the present disclosure includes a first holding unit, a second holding unit, a pressing mechanism and a holding mechanism. The first holding unit is provided with a first heating mechanism and holds a first substrate. The second holding unit disposed facing the first holding unit and provided with a second heating mechanism, holds a second substrate. The pressing mechanism relatively moves the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate. The holding mechanism elastically holds an outer periphery of the first holding unit and the second holding unit.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic plan view illustrating the configuration of a bonding system according to the present exemplary embodiment.

FIG. **2** is a schematic side view illustrating a target substrate and a glass substrate.

FIG. **3** is a schematic cross-sectional plan view illustrating the configuration of a bonding apparatus.

FIG. **4** is a schematic cross-sectional side view illustrating the configuration of the bonding unit.

FIG. **5**A is a schematic cross-sectional side view illustrating the configuration of a first holding unit.

FIG. **5**B is a schematic cross-sectional side view illustrating the configuration of a second holding unit.

FIG. **6**A is a view for describing a situation where a warpage occurs in a first cooling mechanism and a second mechanism in the related art.

FIG. **6**B is a schematic cross-sectional side view illustrating a first cooling mechanism and a second cooling mechanism according to the present exemplary embodiment.

FIG. **7** is a schematic cross-sectional side view illustrating a second holding mechanism.

FIG. **8** is a schematic cross-sectional plan view illustrating an exemplary arrangement of the second holding mechanism.

FIG. **9** is a schematic side view illustrating a second holding mechanism according to a modified embodiment.

FIG. **10**A is a view illustrating a modified embodiment in a case where a stopper is installed to suppress misalignment of the target substrate or the glass substrate.

FIG. **10**B is a view illustrating a modified embodiment in a case where a stopper is installed to suppress misalignment of the target substrate or the glass substrate.

FIG. **11**A is a view for describing an operation example of a bonding processing.

FIG. **11**B is a view for describing an operation example of a bonding processing.

FIG. **12** is a timing chart illustrating a processing sequence of the bonding processing according to the present exemplary embodiment.

FIG. **13** is a flowchart illustrating a processing sequence of a fail-safe processing.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. The illustrative embodiments described in the detailed description, drawing, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here.

When a target substrate and a support substrate are heated, thermal expansion is generated in a chuck due to the heating. Therefore, the chuck may not be fixed completely but fixed by its own weight, for example, in a case of the lower chuck. However, if the chuck is not completely fixed, misalignment of the chuck may occur.

An object of the present disclosure is to provide a bonding apparatus, a bonding system and a bonding method, which can suppress misalignment of the holding unit that holds a substrate.

According to an aspect, the present disclosure provides a bonding apparatus including a first holding unit configured to hold a first substrate; a second holding unit disposed facing the first holding unit and configured to hold a second substrate; a pressing mechanism configured to relatively move the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate; and a holding mechanism configured to elastically hold an outer periphery of the first holding unit and the second holding unit.

In the above-mentioned bonding apparatus, the holding mechanism is provided with a vertically biasing member configured to bias the first holding unit or the second holding unit vertically with respect to a holding surface of the first holding unit or the second holding unit, and holds the first holding unit or the second holding unit elastically by using the vertically biasing member.

In the above-mentioned bonding apparatus, a step dented in the holding surface is provided in the outer periphery of the first holding unit and the second unit, and the holding mechanism is provided with a claw abutting the step and biased vertically by the vertically biasing member.

In the above-mentioned bonding apparatus, the claw is provided with a coil spring on a surface facing the step.

In the above-mentioned bonding apparatus, the holding mechanism is provided with a horizontally biasing member configured to bias the first holding unit or the second holding unit horizontally with respect to the holding surface of the first holding unit or the second holding unit, and holds the first holding unit or the second holding unit elastically by using the horizontally biasing member.

In the above-mentioned bonding apparatus, a plurality of the holding mechanisms are installed with respect to the outer periphery of the first holding unit and the second holding unit.

In the above-mentioned bonding apparatus, the first holding unit and the second holding unit are laminated with a predetermined room in a horizontal direction with respect to a predetermined member.

In the above-mentioned bonding apparatus, wherein each of the first holding unit and the second holding unit is provided with heating mechanisms configure to heat the first substrate or the second substrate, respectively.

The above-mentioned bonding apparatus further includes a chamber configured to accommodate the first holding unit and the second holding unit; and a decompression mechanism configured to decompress the chamber.

In the above-mentioned bonding apparatus, each of the first holding unit and the second holding unit is provided with an electrostatic adsorption unit configured to electrostatically adsorb the first substrate or the second substrate, respectively.

According to another aspect, the present disclosure provides a bonding system including: a carry-in/out station configured to place a first substrate and a second substrate; a substrate transfer apparatus configured to transfer the first substrate and the second substrate placed in the carry-in/out station; and a bonding station provided with a bonding apparatus configured to bond the first substrate and the second substrate transferred by the substrate transfer apparatus. The bonding apparatus includes: a first holding unit configured to hold the first substrate; a second holding unit disposed facing the first holding unit and configured to hold the second substrate; a pressing mechanism configured to relatively move the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate; and a holding mechanism configured to hold the outer periphery of the first holding unit and the second holding unit.

According to another aspect, the present disclosure provides a bonding method including: holding a first substrate by a first holding unit elastically held by a holding mechanism installed in an outer periphery; holding a second substrate by a second holding unit elastically held by a holding mechanism disposed facing the first holding unit and installed in the outer periphery; and pressing the first substrate and the second substrate by relatively moving and contacting the first unit and the second unit.

With the features of the present disclosure, it is possible to suppress misalignment of a holding unit that holds a substrate.

Hereinafter, exemplary embodiments of a bonding apparatus, a bonding system and a bonding method of the present disclosure will be described in detail with reference to the accompanying drawings. Further, it is noted that the present disclosure is not limited to the exemplary embodiments described below.

(First Exemplary Embodiment)

<1. Configuration of Bonding System>

First, the configuration of a bonding system according to the present exemplary embodiment will be described with reference to FIGS. **1** and **2**. FIG. **1** is a schematic plan view illustrating the configuration of the bonding system according to the present exemplary embodiment. In addition, FIG. **2** is a schematic side view illustrating a target substrate and a glass substrate. Meanwhile, in the following, in order to clarify positional relationships, each of the X-axis, Y-axis and Z-axis is defined to be directed as being orthogonal to each other, and the positive direction of the Z-axis is regarded as a vertically upward direction.

A bonding system **1** according to the present exemplary embodiment as illustrated in FIG. **1** bonds a target wafer W and a glass substrate S (see, e.g., FIG. **2**) through an adhesive G to form a superposed substrate T.

Hereinafter, as illustrated in FIG. **2**, among the surfaces of the target substrate W, the surface at the bonding side with the glass substrate S through the adhesive G is referred to as a "bonding surface Wj", and the surface at the opposite side to the bonding surface Wj is referred to as a "non-bonding surface Wn". In addition, among the surfaces of the glass substrate S, the surface at the bonding side with the target substrate W through the adhesive G is referred to as a "bonding surface Sj", and the surface at the opposite side to the bonding surface Sj is referred to as a "non-bonding surface Sn".

The target substrate W is, for example, a substrate having a plurality of electronic circuits formed on a semiconductor substrate such as a silicon wafer or a compound semiconductor wafer, and the surface at a side where electronic circuits are formed is regarded as the bonding surface Wj. After bonded with the glass substrate S, the target substrate W becomes thinner as the non-bonding surface Wn is subjected to polishing.

In the meantime, the glass substrate S serving as a support substrate has approximately the same diameter as that of the target substrate W, and supports the target substrate W. Further, a thermoplastic resin may be used for the adhesive G.

As illustrated in FIG. **1**, the bonding system **1** is provided with a carry-in/out station **2**, a first transfer region **3** and a bonding station **4**. The carry-in/out station **2**, the first transfer region **3** and the bonding station **4** are connected integrally in this order in the positive direction of the X-axis.

The carry-in/out station **2** is configured to place cassettes Cw, Cs, Ct accommodating a plurality (e.g., 25 sheets) of substrates horizontally. In the carry-in/out station **2**, for example, four cassette placing tables **21** are provided side by side in a row. In each of the cassette placing tables **21**, a cassette Cw configured to accommodate a target substrate W, a cassette Cs configured to accommodate a glass substrate S and a cassette Ct configured to accommodate a superposed substrate T are placed, respectively.

The number of the cassette placing tables **21** may be arbitrarily decided. Further, a case where cassettes Ct are placed on two of the four cassette placing tables **21** is exemplified herein, but, for example, a cassette for recovering a substrate in which a failure occurs may be placed on one of the four cassette placing tables **21**.

In the first transfer region **3**, a transfer passage **31** extending in the Y-axis direction and a first transfer device **32** movable along the transfer passage **31** are placed. The first transfer device **32** is also movable in the X-axis direction and rotatable around the Z-axis. The first transfer device **32** transfers a target substrate W, a glass substrate S and a superposed substrate T between the cassettes Cw, Cs, Ct placed on the cassette placing tables **21** and a first delivery unit **41** of the bonding station **4** as described below.

The bonding station **4** is provided with the first delivery unit **41** and a second delivery unit **42**. In addition, the bonding station **4** is provided with an application and heat treatment block G**1** and a bonding processing block G**2**.

The first delivery unit **41** is disposed between the first transfer region **3** and the second transfer region **42**. In the first delivery unit **41**, delivery of a target substrate W, a glass substrate S and a superposed substrate T is performed between the first transfer device **32** in the first transfer region **3** and a second transfer device **420** in the second transfer region **42** as described below.

The second transfer device **420** is disposed in the second transfer region **42**. The second transfer device **420** is also movable in the X-axis direction and the Y-axis direction, and rotatable around the Z-axis. The second transfer device **420** transfers a target substrate W, a glass substrate S and a superposed substrate T between the first delivery unit **41**, the application and heat treatment block G**1** and the bonding processing block G**2**.

The application and heat treatment block G**1** and the bonding processing block G**2** are disposed facing each other across the second transfer region **42**.

In the application and heat treatment block G**1**, two application apparatuses **43** and one heat treatment apparatus **44** are disposed adjacent to the second transfer region **42** side by side. Each of the application apparatuses **43** applies an adhesive G on the bonding surface Wj of the target substrate W, and the heat treatment apparatus **44** heats the target substrate W on which the adhesive G is applied to a predetermined temperature.

In the bonding processing block G**2**, four bonding apparatuses **45** are disposed adjacent to the second transfer region **42** side by side. Each of the bonding apparatuses **45** bonds a target substrate W and a glass substrate S. The configuration of the bonding apparatus **45** will be described in detail below.

Further, the bonding system **1** is provided with a control device **5**. The control device **5** is, for example, a computer, and includes a control unit and a storage unit, which are not illustrated. The storage unit stores a program that controls various processings such as a bonding processing. The control unit controls the operations of the bonding system **1** by reading out and executing the program stored in the storage unit.

In the meantime, the program may be recorded in a recording medium readable by a computer, and installed from the recording medium to the storage unit of the control device **5**. The recording medium readable by a computer may be, for example, a hard disc (HD), a flexible disc (FD), a compact disc (CD), a magnet optical disc (MO) or a memory card.

In the bonding system **1** configured as described above, the first transfer device **32** in the first transfer region **3** takes out a target substrate W first from the cassette Cw placed on the cassette placing table **21**, and transfers the target substrate W taken from the cassette Cw to the first delivery unit **41**. At that time, the target substrate W is transferred in a state where the non-bonding surface Wn is directed downwardly.

The target substrate W transferred to the first delivery unit **41** is extracted from the first delivery unit **41** and carried into the application apparatus **43** in the application and heat treatment block G**1** by the second transfer device **420**. The application apparatus **43** is provided with, for example, a spin chuck, and adsorbs and holds the non-bonding surface Wn of the target substrate W with the spin chuck. The application apparatus **43** then supplies a liquid adhesive G to the bonding surface Wj of the target substrate W while rotating the target substrate W which has been adsorbed and held.

After the adhesive G is applied by the application apparatus **43**, the target substrate W is carried out from the application apparatus **43** and carried into the heat treatment apparatus **44** by the second transfer device **420**. The heat treatment apparatus **44** heats the target substrate W in the inside which is maintained under, for example, an inert atmosphere to volatilize a solvent such as an organic solvent contained in the adhesive G such that the adhesive G becomes harder than when it is applied. Thereafter, the temperature of the target substrate W is adjusted to a predetermined temperature, for example, at room temperature.

After the heat treatment is performed by the heat treatment apparatus **44**, the target substrate W is carried out from the heat treatment apparatus **44** and carried into the bonding apparatus **45** by the second transfer device **420**.

In the meantime, the glass substrate S is taken out from the cassette Cs and transferred to the first delivery unit **41**, and again, is taken out from the first deliver unit **41** and then transferred into the bonding apparatus **45**.

When the target substrate W and the glass substrate S are carried into the bonding apparatus **45**, a bonding processing of the target substrate W and the glass substrate S is performed by the bonding apparatus **45**. As a result, a superposed substrate T is formed. Then, the superposed substrate T is transferred to the first delivery unit **41** by the second transfer device **420**, and then transferred to the cassette Ct by the first transfer device **32**. In this way, a series of processings are terminated.

<2. Configuration of Bonding Apparatus>

The configuration of the bonding apparatus **45** will be described with reference to FIG. **3**. FIG. **3** is a schematic cross-sectional plan view illustrating the configuration of the bonding apparatus **45**.

As illustrated in FIG. **3**, the bonding apparatus **45** is provided with a processing chamber **50** of which the inside is sealable. At the second transfer region **42** side of the processing chamber **50**, a carry-in/out port **51** is provided for a target substrate W, a glass substrate S and a superposed substrate T. The carry-in/out port **51** is provided with an opening/closing shutter (not illustrated).

Inside the processing chamber **50**, an inner wall **52** may be provided to partition the region in the processing chamber **50** into a preprocessing region D**1** and a boding region D**2**. In a case where an inner wall **52** is provided, the inner wall

52 is formed with a carry-in/out port 53 for a target substrate W, a glass substrate S and a superposed substrate T, and the carry-in/out port 53 is provided with an opening/closing shutter (not illustrated). Further, the carry-in/out port 51 described above is formed on the side of the processing chamber 50 in the preprocessing region D1.

In the preprocessing region D1, a delivery unit 60 is provided to deliver a target substrate W, a glass substrate S and a superposed substrate T with the outside of the bonding apparatus 45. The delivery unit 60 is disposed adjacent to the carry-in/out port 51.

The delivery unit 60 is provided with a delivery arm 61 and support pins 62. The delivery arm 61 performs the delivery of a target substrate W, a glass substrate S and a superposed substrate T between the second transfer device 420 (see, e.g., FIG. 1) and the support pins 62. The support pins 62 are provided at a plurality of sites (e.g., three sites) to support the target substrate W, the glass substrate S and the superposed substrate T.

Further, a multiple tiers (e.g., two tiers) of delivery units 60 may be disposed vertically to deliver any two of the target substrate W, the glass substrate S and the superposed substrate T at the same time. For example, one delivery unit 60 may deliver a target substrate W and a glass substrate S before bonding, and another delivery unit 60 may deliver a superposed substrate T after bonding.

At the negative direction side of the Y-axis of the preprocessing region D1, that is, at the carry-in/out port 53 side, an inversion unit 70 configured to invert, for example, the front surface of the target W is provided.

The inversion unit 70 is provided with a holding arm 71 configured to insert and hold a target substrate W or a glass substrate S. The holding arm 71 extends horizontally (in the X-axis direction in FIG. 3), and is pivotable around the horizontal axis as well as movable horizontally (in the X-axis direction and the Y-axis direction) and vertically (in the Z-axis direction).

Further, the inversion unit 70 also has an adjustment function to adjust the horizontal direction of the target substrate W or the glass substrate S. Specifically, the inversion unit 70 is provided with a detection unit 72 configured to detect the position of a notch of the glass substrate S or the target substrate W. And, in the inversion unit 70, by detecting the position of the notch in the detection unit 71 while moving the glass substrate S or the target substrate W held in the holding arm 71, the position of the notch is adjusted so as to adjust the horizontal direction of the target substrate W or the glass substrate S.

At the Y-axis positive direction of the bonding region D2, a transfer unit 80 is provided to transfer a target substrate W, a glass substrate S and a superposed substrate T with respect to the delivery unit 60, the inversion unit 70 and a bonding unit 90 to be described below. The transfer unit 80 is disposed adjacent to the carry-in/out port 53.

The transfer unit 80 is provided with two transfer arms 81, 82. The transfer arms 81, 82 are disposed vertically in two stages in this order from the bottom, and are movable horizontally and vertically by a driving unit (not illustrated).

Among the transfer arms 81, 82, the transfer arm 81 holds and transfers the rear surface, that is, the non-bonding surface Sn of, for example, the glass substrate S. Meanwhile, the transfer arm 82 holds and transfers the outer periphery of the front surface, that is, the bonding surface Wj of the target substrate W of which the front and rear surfaces are inverted in the inversion unit 70.

And, at the negative direction side of the Y-axis of the bonding region D2, a bonding unit 90 configured to bond the target substrate W and the glass substrate S is provided.

In the bonding apparatus 45 configured as described above, when the target substrate W is delivered to the delivery arm 61 of the delivery unit 60 by the second transfer device 420, the delivery arm 61 delivers the target substrate W to the support pins 62. Thereafter, the target substrate W is transferred from the support pins 62 to the inversion unit 70 by the transfer 81 of the transfer unit 80.

For the target substrate W transferred to the inversion unit 70, as the position of the notch is detected by the detection unit 72 of the inversion unit 70, the horizontal direction of the target substrate W is adjusted. Thereafter, the target substrate W is inverted by the inversion unit 70. That is, the bonding surface Wj is directed downwardly.

Subsequently, the target substrate W is transferred from the inversion unit 70 to the bonding unit 90 by the transfer arm 82 of the transfer unit 80. At this time, since the transfer arm 82 holds the outer periphery of the target substrate W, the bonding surface Wj may be suppressed from being contaminated and damaged by, for example, particles attached to the transfer arm 82.

In the meantime, when the glass substrate S is delivered to the delivery arm 61 of the delivery unit 60 by the second transfer device 420, the delivery arm 61 delivers the glass substrate S to the support pins 62. Thereafter, the glass substrate S is transferred from the support pins 62 to the inversion unit 70 by the transfer arm 81 of the transfer unit 80.

For the glass substrate S transferred to the inversion unit 70, as the position of the notch is detected by the detection unit 72 of the inversion unit 70, the horizontal direction of the glass substrate S is adjusted. Thereafter, the glass substrate S is transferred from the inversion unit 70 to the bonding unit 90 by the transfer arm 81 of the transfer unit 80.

When the carry-in operation of the target substrate W and the glass substrate S to the bonding unit 90 is terminated, the target substrate W and the glass substrate S are bonded to each other by the bonding unit 90 to form a superposed substrate T. The superposed substrate T formed as described above is transferred from the bonding unit 90 to the delivery unit 60 by the transfer arm 81 of the transfer unit 80, delivered to the delivery arm 61 via the support pins 62, and then, delivered from the delivery arm 61 to the second transfer device 420 again.

<3. Configuration of Bonding Unit>

The configuration of the bonding unit 90 will be described with reference to FIG. 4. FIG. 4 is a schematic cross-sectional side view illustrating the configuration of the bonding unit 90. In FIG. 4, only the components necessary to explain the characteristics of the bonding unit 90 are illustrated, and common components are omitted.

As illustrated in FIG. 4, the bonding unit 90 is provided with a first holding unit 101 and a second holding unit 201. The first holding unit 101 is disposed above the second holding unit 201 to hold the target substrate W. In addition, the second holding unit 201 holds the glass substrate S. The first holding unit 101 and the second holding unit 201 are substantially disc-shaped and have a diameter larger than those of the target substrate W and the glass substrate S.

The first holding unit 101 and the second holding unit 201 are electrostatic chucks and hold the target substrate W and the glass substrate S, respectively, by electrostatic adsorption. Here, the configurations of the first holding unit 101 and the second holding unit 201 will be described with reference to FIGS. 5A and 5B. FIG. 5A is a schematic cross-sectional side view illustrating the configuration of the first holding unit **101**. FIG. **5**B is a schematic cross-sectional side view illustrating the configuration of the second holding unit **201**.

As illustrated in FIGS. **5**A and **5**B, the first holding unit **101** and the second holding unit **201** are provided with electrostatic adsorption units **111**, **211**, respectively.

Each of the electrostatic adsorption units **111**, **211** is provided with a plurality of internal electrodes **111***a*, **211***a*, respectively, and adsorb the non-bonding surface Wn of the target substrate W and the non-bonding surface Sn of the glass substrate S, respectively, by using an electrostatic force generated on each of holding surfaces **113**, **213** by the internal electrodes **111***a*, **211***a*.

As described above, since the bonding unit **90** uses electrostatic chucks as the first holding unit **101** and the second holding unit **201**, the target substrate W and the glass substrate S may be securely held under a reduced pressure atmosphere.

That is, although a vacuum chuck configured to adsorb and hold using negative pressure may be considered as a holding unit, such a holding unit has a reduced adsorption force under a reduced pressure environment, and thus, there is a concern that the target substrate W and the glass substrate S may fall or misalignment occurs. In contrast, since the adsorption force of the electrostatic chuck is not reduced even under a vacuum environment, the target substrate W and the glass substrate S may be securely held.

Further, in a case where a mechanical chuck that performs mechanical holding is used as a holding unit, there is a concern that the target substrate W and the glass substrate S may be damaged. However, the electrostatic chuck hardly damages the target substrate W and the glass substrate S, as compared to the mechanical chuck.

Further, it may be considered that a vacuum chuck is used for the second holding unit **201** and a rubber pad is provided on its holding surface, thereby suppressing misalignment of the glass substrate S under a reduced pressure atmosphere. However, it is not possible to use a rubber pad in a case where a bonding processing is performed under a high temperature environment exceeding the heat-resistant as in the bonding unit **90** according to the present exemplary embodiment.

Accordingly, in the bonding unit **90** according to the present exemplary embodiment, electrostatic chucks may be used for both of the first holding unit **101** and the second holding unit **201**. Further, the heat-resistant temperature of a fluorine rubber known for its high heat-resistance is 300° C. However, in the bonding system **1** according to the present exemplary embodiment, the bonding processing of the target substrate W and the glass substrate S is performed under a high temperature environment of 300° C. or higher.

As illustrated in FIGS. **5**A and **5**B, the first holding unit **101** and the second holding unit **201** are provided with vacuum adsorption units **112**, **212**, respectively, in addition to the electrostatic adsorption units **111**, **211**.

The vacuum adsorption units **112**, **212** are provided with intake spaces **112***a*, **212***a* and a plurality of through-holes **112***b*, **212***b* in communication with the intake spaces **112***a*, **212***a* from the holding surfaces **113**, **213**.

The vacuum adsorption units **112**, **212** use negative pressure generated by intake of intake devices **115**, **215** to adsorb the non-bonding surface Wn of the target substrate W and the non-bonding surface Sn of the glass substrate S, respectively, thereby holding the target substrate W and the glass substrate S.

Meanwhile, the first holding unit **101** and the second holding unit **201** are formed of ceramics such as aluminum nitride.

Further, in the outer periphery of the first holding unit **101** and the second holding unit **201**, steps **116**, **216** dented in a thickness direction with respect to the holding surfaces **113**, **213** are provided. The steps **116**, **216** are provided with a first holding mechanism **401** and a second holding mechanism (see, e.g., FIG. **4**).

The first holding mechanism **401** and the second holding mechanism **402** elastically hold the first holding unit **101** and the second holding unit **201**, respectively. The first holding mechanism **401** and the second holding mechanism **402** will be described below.

Referring back to FIG. **4**, descriptions will be continued on the first holding unit **101** and the second holding unit **201**. Each of the first holding unit **101** and the second holding unit **201** is equipped with a first heating mechanism **117** and a second heating mechanism **217**, respectively, built therein. The first heating mechanism **117** heats the target substrate W held by the first holding unit **101**, and the second heating mechanism **217** heats the glass substrate S held by the second holding unit **201**.

The bonding processing of the target substrate W and the glass substrate S is performed under a reduced pressure atmosphere. Therefore, the first heating mechanism **117** built in the first holding unit **101** may be a ceramic heater which is also available under a reduced pressure atmosphere.

Meanwhile, since the second holding unit **201** is formed with through-holes configured to insert a first temperature detection unit **301** (to be described below) therethrough, it is difficult to dispose a sheath heater. Therefore, a ceramic heater is used as the second heating mechanism **217** built in the second holding unit **201**.

Further, the bonding unit **90** is provided with a first cooling mechanism **102**, a third heating mechanism **103**, pressing units **104**, a base member **105** and a pressing mechanism **106**.

The first cooling mechanism **102** is provided in contact with a surface opposite to the holding surface **113** (see, e.g., FIG. **5**A) of the first holding unit **101**. The first cooling mechanism **102** may be, for example, a cooling jacket made of metal, and cools the first holding unit **101** by using a cooling fluid such as cold water as a medium such that the target substrate W held in the first holding unit **101** is cooled.

The third heating mechanism **103** is formed with, for example, a disc shape having substantially the same diameter as that of the target substrate W. The third heating mechanism **103** is disposed on a surface of the first cooling mechanism **102** opposite to the surface on which the first holding unit **101** is disposed, and heats the first cooling mechanism **102**. The third heating mechanism **103** may be a sheath heater which is also available under a reduced pressure atmosphere.

The pressing units **104** press the third heating mechanism **103** to the first cooling mechanism **102**. Each of the pressing unit **104** is provided with a plate **141** and a support member **142**. The plate **141** is disc-shaped metal member having substantially the same diameter as that of the third heating member **103**, and is disposed on the top surface of the third heating mechanism **103**. A plurality of support members **142** is stretchable vertically and disposed on the top surface of the plate **141** to suppress misalignment of the plate **141** and the third heating mechanism **103**.

The pressing units **104** may press the third heating mechanism **103** to the first cooling mechanism **102** by the weight of the plates **141**. Alternatively, biasing members such as coil spring may be provided inside the support members **142** so as to press the third heating mechanism **103** to the first cooling mechanism **102**. As such, by pressing the third heating mechanism **103** to the first cooling mechanism **12** to bring the third heating mechanism **103** into close contact with the first cooling mechanism **102**, it is possible to more securely suppress the first cooling mechanism **102** from being warped due to thermal deformation.

The base member **105** is attached to the top surface of the first chamber portion **511** (to be described below) above the pressing units **104**. Further, the upper ends of the support members **142** are fixed to, for example, the bottom surface of the base member **105**.

The pressing mechanism **106** moves the first holding unit **101** vertically downward to contact and press the target substrate W to the glass substrate S. The pressing mechanism **106** is provided with a pressure vessel **161**, a gas supply pipe **162** and a gas supply source **163**.

The pressure vessel **106** is constituted with a stainless steel bellows that can be stretchable vertically. The lower end of the pressure vessel **161** is fixed to the top surface of the first cooling mechanism **102**, and the upper end is fixed to the lower surface of the base member **105**. Further, the above-mentioned third heating mechanism **103** and pressing units **104** are disposed inside the pressure vessel **161**.

The gas supply pipe **162** is connected to the pressure vessel **161** through the base member **105** and a first chamber portion **511** (to be described below) at one end thereof, and connected to the gas supply source **163** at the other end thereof.

The pressure vessel **161** is stretched by gas supplied from the gas supply source **163** to the inside of the pressure vessel **161** through the gas supply so as to move down the first holding unit **101**. Accordingly, the target substrate W is contacted and pressed to the glass substrate S. The pressing force of the target substrate W and the glass substrate S is adjusted by adjusting the pressure of the gas supplied to the pressure vessel **161**.

Meanwhile, since the pressure vessel **161** has stretchability, even if there is a difference in parallelism between the first holding unit **101** and the second holding unit **201**, the difference may be absorbed. Further, since the inside of the pressure vessel **161** is evenly pressed by gas, the target substrate W and the glass substrate S may be evenly pressed.

Further, the bonding unit **90** is provided with a second cooling mechanism **202**, a fourth heating mechanism **203** and a spacer **204**. The second cooling mechanism **202**, the fourth heating mechanism **203** and the spacer **204** are laminated in the order of the spacer **204**, the fourth heating mechanism **203**, the second cooling mechanism **202** and the second holding unit **201** from the bottom.

The second cooling mechanism **202** is formed with, for example, a disc shape having substantially the same diameter as that of the second holding unit **201**. The second cooling mechanism **202** is provided in contact with a surface opposite to the holding surface **213** (see FIG. **5**B) of the second holding unit **201**. Similarly to the first cooling mechanism **102**, the second cooling mechanism **202** may be, for example, a cooling jacket made of metal, and cools the second holding unit **201** by using a cooling fluid such as cold water as a medium such that the glass substrate S held in the second holding unit **201** is cooled.

The fourth heating mechanism **203** is formed with, for example, a disc shape having a diameter larger than that of the second cooling mechanism **202**. The fourth heating mechanism **203** is disposed on a surface of the second cooling mechanism **202** opposite to the surface on which the second holding unit **201** is disposed, and heats the second cooling mechanism **202**. The fourth heating mechanism **203** may be a sheath heater for the same reason as in the first heating mechanism **117**.

The spacer **204** is a member disposed on the bottom surface of the fourth heating mechanism **203**, and is installed in order to adjust, for example, the height of the second holding unit **201**. The spacer **204** is disposed on the bottom surface of the second chamber portion **512** to be described below. Further, the bonding unit **90** is not necessarily provided with the spacer **204**.

As described above, in the bonding unit **90** according to the present exemplary embodiment, the first heating mechanism **117** and the third heating mechanism **103** are provided so as to sandwich the upper and lower surfaces of the first cooling mechanism **102** therebetween, and the second heating mechanism **217** and the fourth heating mechanism **203** are provided so as to sandwich the upper and lower surfaces of the second cooling mechanism **202** therebetween. As a result, the first cooling mechanism **102** and the second cooling mechanism **202** may be suppressed from being warped by heating, and the first holding unit **101** and the second holding unit **201** may be suppressed from being damaged by such warpage.

In this regard, descriptions will be made with reference to FIGS. **6**A and **6**B. FIG. **6**A is a view for describing a situation that warpage occurs in a first cooling mechanism and a second mechanism in the related art. FIG. **6**B is a schematic cross-sectional side view illustrating the first cooling mechanism **102** and the second cooling mechanism **102** according to the present exemplary embodiment.

As illustrated in FIG. **6**A, conventionally, a first heating mechanism **117**X of a first holding unit **101**X is provided below a first cooling mechanism **102**X, and a second heating mechanism **217**X of a second holding unit **201**X is provided above a second cooling mechanism **202**X.

Therefore, conventionally, when heating is performed by the first heating mechanism **117**X and the second heating mechanism **217**X, a temperature difference is likely to occur between the upper and lower surfaces of the first cooling mechanism **102**X and the second cooling mechanism **202**X. Especially, when heating operation is performed under a reduced pressure atmosphere, since the thermal conductivity of the gas is decreased by the reduced pressure, a large temperature difference is likely to occur between a portion in contact with the gas and a portion not in contact with the gas, that is, a portion in contact with the first holding unit **101**X and the second holding unit **201**X and a portion not in contact with the first holding unit **101**X and the second holding unit **201**X.

As a result, warpage is likely to occur in the first cooling mechanism **102**X and the second cooling mechanism **202**X in the related art. The first holding unit **101**X and the second holding unit **201**X are formed of ceramics which has low toughness as compared to metal. Therefore, since stress caused by the warpage of the first cooling mechanism **102**X and the second cooling mechanism **202**X is applied to the first holding unit **101**X and the second holding unit **201**X, there is a concern that damages such as crack may occur in the first holding unit **101**X and the second holding unit **201**X.

Accordingly, in the bonding unit **90** according to the present exemplary embodiment, as illustrated in FIG. **3**B, the third heating mechanism **103** is further provided on the top surface of the first cooling mechanism **102**, and the fourth heating mechanism **203** is further provided on the lower surface of the second cooling mechanism **202**.

As a result, since the temperature difference is suppressed from occurring between the upper and lower surfaces of the first cooling mechanism **102** and the second cooling mechanism **202**, the first cooling mechanism **102** and the second cooling mechanism **202** may be suppressed from being warped. Therefore, by the bonding unit **90** according to the present exemplary embodiment, it is possible to suppress the first holding unit **101** and the second holding unit **201** from being damaged.

As illustrated in FIG. **4**, the first holding unit **101** is provided with a first temperature detection unit **303** configured to detect a temperature of the target substrate W. Further, a second temperature detection unit **302** configured to detect a temperature of the first cooling mechanism **102** is attached to an outer periphery of the first cooling mechanism **102**. For example, thermocouples may be used for the first temperature detection unit **303** and the second temperature detection unit **302**.

The detection results of the first temperature detection unit **303** and the second temperature detection unit **302** are transmitted to a control device **5**. Then, in a case where the control device **5** determines that warpage occurs in the first cooling mechanism **102** based on the detection result, the control device **5** executes a fail-safe processing which stops heating by the first heating mechanism **117** and the like.

Similarly, the second holding unit **201** is provided with a first temperature detection unit **301** configured to detect a temperature of the glass substrate W. A second temperature detection unit **304** configured to detect a temperature of the second cooling mechanism **202** is attached to an outer periphery of the second cooling mechanism **202**. For example, thermocouples are used for the first temperature detection unit **301** and the second temperature detection unit **304**.

The detection results of the first temperature detection unit **301** and the second temperature detection unit **304** are transmitted to a control device **5**. Then, in a case where the control device **5** determines that warpage occurs in the second cooling mechanism **202** based on the detection result, the control device **5** also executes a fail-safe processing which stops heating by the first heating mechanism **117** and the like.

By providing such a fail-safe processing, even if warpage occurs in the first cooling mechanism **102** and the second cooling mechanism **202**, it is possible to suppress further warpage from occurring, and thus, it is possible to suppress the first holding unit **101** and the second holding unit **201** from being damaged. Further, the fail-safe processing will be described below with reference to FIG. **13**.

Further, as illustrated in FIG. **6**A, the first cooling mechanism **102** and the second cooling mechanism **202** are likely to be warped in a direction away from the first holding unit **101** and the second holding unit **201**. Therefore, as the warpage of the first cooling mechanism **102** and the second cooling mechanism **202** becomes larger, a difference will occur between the temperatures of the outer peripheries of the first cooling mechanism **102** and the second cooling mechanism **202** and the temperatures of the first holding unit **101** and the second holding unit **201**.

Accordingly, by providing the second temperature detection units **302**, **304** in the outer peripheries of the first cooling mechanism **102** and the second cooling mechanism **202**, respectively, to detect the temperatures of the outer peripheries of the first cooling mechanism **102** and the second cooling mechanism **202**, the warpage of the first cooling mechanism **102** and the second cooling mechanism **202** may be detected properly.

The present exemplary embodiment has been described with reference to an example in which the second temperature detection units **302**, **304** are provided in both of the first cooling mechanism **102** and the second cooling mechanism **202**. However, the second temperature detection units **302**, **304** may be provided in any one of the first cooling mechanism **102** and the second cooling mechanism **202**. Further, the first temperature detection units **301**, **303** may also be provided in any one of the first cooling mechanism **102** and the second cooling mechanism **202**.

The first holding mechanism **401** and the second holding mechanism **402** will be described hereinafter. The above-mentioned first holding unit **101** is centered to some extent by positioning pins **11** without being fixed to the first cooling mechanism **102** and, but is laminated with a predetermined room in a horizontal direction. If the first holding unit **101** and the first cooling mechanism **102** are completely fixed and thermal expansion occurs as the first holding unit **101** and the first cooling mechanism **102** are heated, there is a concern that the first holding unit **101** and the first cooling mechanism **102** may be damaged because there is no room as much as thermally expanded portion.

Further, the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203** and the spacer **204** are not completely fixed to each other for the same reason, and are laminated with a predetermined room in a horizontal direction. Particularly, the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203** and the spacer **204** are centered to some extent by the positioning pins, respectively, and are in a state where the rotation thereof is restricted to some extent by detent pins **12**.

As such, the first holding unit **101** and the second holding unit **201** are not completely fixed and is laminated with a predetermined room in a horizontal direction with respect to other adjacent members (herein, the cooling mechanism **102** and the second cooling mechanism **202**). Therefore, horizontal misalignment is likely to occur in the first holding unit **101** and the second holding unit **201**. Particularly, in a case where the boding processing is performed under a reduced pressure environment, misalignment of the first holding unit **101** and the second holding unit **201** is likely to occur during the procedure decompressing the inside of the chamber **501** (to be described below) by intake.

Thus, if misalignment occurs in the first holding unit **101** and the second holding unit **201**, the target substrate W and the glass substrate S may be bonded in a misaligned state.

Therefore, in the bonding unit **90** according to the present exemplary embodiment, the first holding unit **101** and the second holding unit **201** are elastically held by the first holding mechanism **401** and the second holding mechanism **402**, respectively. Accordingly, it is possible to suppress misalignment of the first holding unit **101** and the second holding unit **201** while tolerating the thermal expansion due to heating.

The first holding mechanism **401** is disposed between the first holding unit **101** and the first chamber portion **511** (to be described below) to elastically hold the outer periphery of the first holding unit **101**. Further, the second holding mechanism **402** is disposed between the second holding unit **201** and the second chamber portion **512** (to be described below) to elastically hold the outer periphery of the first holding unit **201**.

Here, the entire configuration of the second holding mechanism **402** will be described with reference to FIGS. **7** and **8**. FIG. **7** is a schematic cross-sectional side view of the second holding mechanism **402**. Further, FIG. **8** is a schematic cross-sectional plan view illustrating an example of arrangement of the second holding mechanism **402**.

As illustrated in FIG. **7**, the second holding mechanism **402** is provided with a base **421**, a claw **422**, a vertically biasing portion **423** and a support **424**.

The base **421** is formed substantially in an arc shape when viewed from the top and disposed adjacent to an outer periphery of the fourth heating mechanism **203**. The lower end of the base **421** is fixed to, for example, the bottom surface of the second chamber portion **512**.

The claw **422** is a member formed in a substantially toenail-like shape when viewed from the side. The base end of the claw **422** is disposed at a predetermined interval on the top of the base **421**, and the front end is disposed on the top of a step **216** of the second holding unit **201**.

The claw **422** is provided with a coil spring **422***b* on a facing surface **422***a* to the step **216** of the second holding unit **201**. The coil spring **422***b* is installed transversely on the facing surface **422***a* in a state of being curved along the circumferential direction of the step **216**.

The vertically biasing portion **423** biases the claw **422** in the Z-axis negative direction. Particularly, the vertically biasing portion **423** is provided with a shaft **423***a*, a locking portion **423***b* and a vertically biasing member **423***c*. The shaft **423***a* is a member that extends in the Z-axis direction. The shaft **423***a* is provided so as to penetrate the base end of the claw **422**, and the base end of the shaft **423***a* is fixed to the base **421**. The shaft **423***a* is formed with a screw groove.

The locking portion **423***b* is attached to the shaft **423***a*. The locking portion **423***b* includes, for example, a nut, and is capable of adjusting the position in the Z-axis direction by turning it along the screw groove formed on the shaft **423***a*.

The vertically biasing member **423***c* is provided between the top surface of the base end of the claw **422** and the locking portion **423***b*, and biases the claw **422** in the Z-axis negative direction.

The support **424** is a member configured to maintain the horizontality of the claw **422**, and constituted with, for example, a nut **424***a* and a headless bolt **424***b*. The support **424** may adjust the horizontality of the claw **422** by tightening or loosening the nut **424***a* to the headless bolt **424***b*.

The second holding mechanism **402** is configured as described above, and as the claw **422** is biased in the Z-axis negative direction by the vertically biasing portion **423**, the claw **422** biases the second holding unit **201** in the Z-axis negative direction. As a result, the second holding unit **201** is elastically held.

As described above, in the bonding unit **90**, the second holding mechanism is used to elastically hold the outer periphery of the second holding unit **201**. Accordingly, in a case where the second holding unit **201** is not fixed in consideration of thermal expansion, it is possible to suppress misalignment of the second holding unit **201** while tolerating the thermal expansion of the second holding unit **201** due to heating.

Further, since the claw **422** of the second holding mechanism **402** is provided with the coil spring **422***b* on the facing surface **422***a* with respect to the step **216** of the second holding unit **201**, it is possible to more elastically hold the second holding unit **201** in a less contact area. As a result, it is possible to suppress, for example, the contact site of the second holding unit **201** with the second holding mechanism **402** from being damaged.

Further, in the bonding unit **90**, the bonding processing of the target substrate W and the glass substrate S is performed under a high-temperature environment higher than the heat-resistant temperature of a fluorine rubber known for its high heat-resistance. For this reason, a metal coil spring **422***b* may be suitable for the member installed on the facing surface **422***a* of the claw **422** with respect to the step **422***a*.

Further, the second holding mechanism **402** is configured such that the claw **422** abuts onto the step **216** of the second holding unit **201**, and is formed at a height to the extent that the second holding mechanism **402** does not protrude out of the holding surface **213** of the second holding unit **201**. Accordingly, even when the first holding unit **101** and the second holding unit **201** approach each other during the bonding processing to be described below, the second holding mechanism **402** does not interfere.

The second holding mechanism **402** is provided in plural numbers for the outer periphery of the second holding unit **201**. For example, as illustrated in FIG. **8**, the step **216** of the second holding unit **201** is provided with three second holding mechanisms **402** arranged at even intervals in the circumferential direction of the second holding unit **201**. As a result, it is possible to more evenly tolerate the thermal expansion of the second holding unit **201** due to heating.

Further, the step **216** of the second holding unit **201** is further provided with a bolt **13** in order to prevent rotation of the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203** and the spacer **204**.

Although a case where the second holding unit **201** is provided with three second holding mechanisms **402** is exemplified herein, the number of the second holding mechanisms **402** provided in the second holding unit **201** is not limited to three.

As illustrated in FIG. **4**, the first holding mechanism **401** also elastically hold the first holding unit **101** in the same manner as the second holding mechanism **402** as described above. As illustrated in FIG. **4**, the first holding mechanism **401** is provided with a claw **411** and a vertically biasing member **412**. The front end of the claw **411** abuts onto the step **116** of the first holding unit **101**, and the vertically biasing member **412** biases the claw **411** in the Z-axis positive direction. As a result, similarly to the second holding unit **201**, the first holding unit **101** is elastically held. Further, similarly to the claw **422** of the second holding mechanism **402**, the claw **411** is provided with a coil spring (not illustrated) on the facing surface with respect to the step of the first holding unit **101**. Further, the first holding mechanism **401** is provided in plural numbers for the outer periphery of the first holding unit **201** in the same manner as the second holding mechanism **402**.

However, each of the first holding mechanism **401** and the second holding mechanism **402** may be further provided with a horizontally biasing member configured bias the first holding unit **101** or the second holding unit **201** in the horizontal direction with respect to the holding surfaces **113**, **213**. In this connection, description will be made on a case where the second holding mechanism is provided with a horizontally biasing member with reference to FIG. **9**. FIG. **9** is a schematic side view illustrating a second holding mechanism according to a modified embodiment.

As illustrated in FIG. **9**, a second holding mechanism **402**A according to the modified embodiment is provided with a support **425**, a holding pin **426** and a horizontally biasing member **427**. The support **425** is a member that extends in the Z-axis direction, and is fixed to the top surface of a base **421** at its base end.

The holding pin **426** is a rod-like member that extends horizontally (here, the X-axis direction), and is supported at its base end to be movable forwardly and rearwardly in the support **425**. The front end of the holding pin **426** abuts onto a sidewall **218** connecting to the holding surface **213** of the second holding unit **201** and the step **216**. Further, a locking portion **426***a* having a diameter larger than that of the holding pin **426** is formed in the middle of the holding pin **426**.

The horizontally biasing member **427** is provided between the locking portion **426***a* of the holding pin **426** and the support **425**, and biases the holding pin **426** horizontally (here, the X-axis positive direction). As a result, the second holding unit **201** is biased horizontally forward the center.

As such, since the second holding mechanism **402**A is further provided with the horizontally biasing member **427**, it is possible to more securely suppress misalignment of the second holding unit.

Although a case is described herein where the second holding mechanism **402**A is provided with both of the vertically biasing member **423***c* and the horizontally biasing member **427**, the second holding mechanism **402**A may not be provided with the vertically biasing member **423***c*.

Further, in the bonding unit **90**, a stopper may be provided in the outer periphery of the first holding unit **101** or the second holding unit **201** in order to suppress considerable misalignment of the target substrate W or the glass substrate S. In this connection, description will be made with reference to FIGS. **10**A and **10**B. FIGS. **10**A and **10**B are views illustrating a modified embodiment in a case where a stopper is installed to suppress misalignment of the target substrate or the glass substrate.

As illustrated in FIG. **10**A, a stopper **219***a* for suppressing misalignment is provided in, for example, the outer periphery of the holding surface **13** of the second holding unit **201**. Accordingly, for example, even if misalignment occurs as the target substrate W or the glass substrate, considerable alignment may be suppressed by abutting onto the stopper **219***a*. Further, the stopper **219***a* may be thicker than the glass substrate S and thinner than the total thickness of the target substrate W, the glass substrate S and the adhesive G.

Further, as illustrated in FIG. **10**B, a stopper **219***b* may be provided on the top of the bolt **13** provided on the step **216** of the second holding unit **201**. Similarly to the case illustrated in F**10**A, in this case, considerable alignment of the target substrate W or the glass substrate S may also be suppressed as the target substrate W or the glass substrate S, which causes misalignment, abuts onto the stopper **219***b*.

Further, as illustrated in FIG. **10**B, the bolt **13** is provided such that its head is spaced at a predetermined distance d from the top surface of the step **216**. Therefore, when the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203** and the spacer **204** thermally expand vertically due to heating, the second holding unit **201** may be suppressed from being damaged. Further, an insertion through-hole **216***a* for the bolt **13** may be formed in an oval shape which is long in a radial direction of the second holding unit **201**, instead of a perfect circular shape. Therefore, when the second holding unit **201** thermally expands horizontally due to heating, the second holding unit **201** may be suppressed from being damaged.

Referring back to FIG. **4**, descriptions of the bonding unit **90** will be continued. Each of the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203**, the spacer **204**, the second chamber portion **512** and the respective positioning pins **11** is formed with a through-hole that penetrates vertically. And, as the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203**, the spacer **204**, the second chamber portion **512** and the respective positioning pins **11** are laminated, a through-hole **205** that penetrates from the bottom surface of the second chamber portion **512** to the top surface of the second holding unit **201** is formed. The first temperature detection unit **301** configured to detect a temperature of the glass substrate S is inserted through the through-hole **205**.

Further, the bonding unit **90** is provided with a chamber **501**, movement mechanisms **502**, a decompression mechanism **503**, a first image capturing unit **504** and a second image capturing unit **505**.

The chamber **501** is a processing container of which the inside is sealable, and is provided with the first chamber portion **511** and the second chamber portion **512**. The first chamber portion **511** is a bottomed cylindrical container of which the lower part is opened, and accommodates the first holding unit **101**, the first cooling mechanism **102**, the third heating mechanism **103**, the pressing units **104**, the pressure vessel **161**, the second temperature detection unit **302** and the first holding mechanisms **401** therein. In addition, the second chamber portion **512** is a bottomed cylindrical container of which the upper part is opened, and accommodates the second holding unit **201**, the second cooling mechanism **202**, the fourth heating mechanism **203**, the spacer **204** and the second holding mechanism **402** therein.

The first chamber portion **511** is configured to be movable up and down vertically by an elevation mechanism (not illustrated) such as an air cylinder. As the first chamber portion **511** is moved down by such an elevation mechanism to abut onto the second chamber portion **512**, a closed space is formed inside the chamber **501**. Further, on the abutting surface of the first chamber portion **511** onto the second chamber portion **512**, a seal member **513** is provided so as to secure a sealability of the chamber **501**. The seal member **513** may be, for example, an O-ring.

The movement mechanisms **502** are provided in the outer periphery of the first chamber portion **511**, and move the first holding unit **101** horizontally through the first chamber portion **511**. A plurality of (e.g., five) movement mechanisms **502** are provided in the outer periphery of the first chamber portion **511**. Four of five movement mechanisms **502** are used for horizontal movement of the first holding unit **101**, and the remaining one is used for rotation of the first holding unit **101** around the vertical axis.

Each of the movement mechanisms **502** is provided with a cam **521** configured to abut onto the outer periphery of the first chamber portion **511** and move the first holding unit **101**, and a rotation driving unit **523** configured to rotate the cam **521** through a shaft **522**. The cam **521** is provided eccentrically with respect to the central axis of the shaft **522**. And, when the cam **521** is rotated by the rotation driving unit **523**, the central position of the cam **521** may move to allow the first holding unit **101** to move horizontally.

The decompression mechanism **503** is provided in, for example, the lower portion of the second chamber portion **512**, and decompresses inside the chamber **501**. The decompression mechanism **503** is provided with an intake pipe **531** configured to intake an atmosphere inside the chamber **501**, and an intake device **532**, such as a vacuum pump, connected to the intake pipe **531**.

The first image capturing unit **504** is disposed below the first holding unit **101** to capture the surface image of the target substrate W held in the first holding unit **101**. Further, the second image capturing unit **505** is disposed above the second holding unit **201** to capture the surface image of the glass surface S held in the second holding unit **201**.

The first image capturing unit **504** and the second image capturing unit **505** are configured to be movable horizontally by a movement mechanism (not illustrated), and capture images of the target substrate W and the glass substrate S by entering the chamber **201** before the first chamber portion **511** moves down. The image data of the first image capturing unit **504** and the second image capturing unit **505** are transmitted to the control device **5**. Further, each of the first image capturing unit **504** and the second image capturing unit **505** may be, for example, a wide-angle type CCD camera.

<4. Operations of Bonding Unit>

Referring to FIGS. **11**A and **11**B, descriptions will be made on the processing sequence of the bonding processing performed by the bonding unit **90** configured as described above. FIGS. **11**A and **11**B are views for describing an operation example of the bonding processing.

In the bonding unit **90**, the target substrate W is held first by the first holding unit **101**, and the glass substrate S is held by the second holding unit **201**. At this time, the first holding unit **101** and the second holding unit **201** are heated to a first temperature in advance by the first heating mechanism **117** of the first holding unit **101** and the second heating mechanism **217** of the second holding unit **201**, respectively. The first temperature is, for example, 200° C. or lower.

Further, at this time, the third heating mechanism **103** and the fourth heating mechanism **203** also perform heating to the same first temperature as in the first heating mechanism **117** and the second heating mechanism **217**. Therefore, the first cooling mechanism **102** and the second cooling mechanism **202** are suppressed from being warped, and thus, the first holding unit **101** and the second holding unit **201** are prevented from being damaged.

Subsequently, in the bonding unit **90**, an alignment processing is performed. In the alignment processing, the first image capturing unit **504** and the second image capturing unit **505** as illustrated in FIG. **4** move horizontally to enter the chamber **501**, and capture images of the surfaces of the target substrate W and the glass substrate S, respectively.

Thereafter, the horizontal position of the target substrate W is adjusted by the movement mechanisms **502** so that the position of the reference point of the target substrate W displayed in the image captured by the first image capturing unit **504** accords with the position of the reference point of the glass substrate S displayed in the image captured by the second image capturing unit **505**. Therefore, the horizontal position of the target substrate W with respect to the glass substrate S is adjusted.

Subsequently, after the first image capturing unit **504** and the second image capturing unit **505** retreat from the chamber **501**, the first chamber **511** moves down by movement mechanisms (not illustrated). Then, as the first chamber portion **511** abuts onto the second chamber portion **512**, a sealed space is formed in the chamber **501** (see FIG. **11**A).

Subsequently, the decompression processing is performed in the bonding unit **90**. In the decompression processing, the atmosphere in the chamber **501** is sucked by the decompression mechanism **503** such that the inside of the chamber **501** is decompressed. As described above, since the first holding unit **101** and the second holding unit **201** are elastically held by the first holding mechanisms **401** and the second holding mechanisms **402**, misalignment does not occur during the decompression processing.

Thereafter, a temperature increasing processing is performed in the bonding unit **90**. In the temperature increasing processing, the target substrate W and the glass substrate S are heated by the first heating mechanism **117** of the first holding unit **101** and the second heating mechanism **217** of the second holding unit **201**. In such a temperature increasing processing, the target substrate W and the glass substrate

S are heated from the first temperature to a second temperature. The second temperature is, for example, 300° C. or higher.

At this time, the third heating mechanism **103** and the fourth heating mechanism **203** also heat the target substrate W and the glass substrate S to the second temperature at the same heating rate as in the first heating mechanism **117** and the second heating mechanism **217**. Accordingly, the first cooling mechanism **12** and the second cooling mechanism are suppressed from being warped, and thus, the first holding unit **101** and the second holding unit **201** are prevented from being damaged.

Subsequently, a main bonding processing is performed in the bonding unit **90**. In the main bonding processing, the pressure vessel **161** is pressurized to a predetermined pressure by supplying gas to the pressure vessel **161**. Accordingly, the first holding unit **101** moves down such that the target substrate W and the glass substrate S are pressed at a predetermined pressure (see FIG. **11**B). The adhesive G applied onto the bonding surface Wj of the target substrate W is softened by the heating to the second temperature, and the target substrate W is pressed to the glass substrate S at a predetermined pressure such that the target substrate W and the glass substrate S are bonded to each other.

Further, by decompressing the atmosphere in the chamber **501**, it is possible to suppress voids from occurring between the target substrate W and the glass substrate S.

Subsequently, a temperature decreasing processing is performed in the bonding unit **90**. In the temperature decreasing processing, the target substrate W and the glass substrate S are cooled to the first temperature while maintaining the state where the target substrate W and the glass substrate S are pressed by the pressing mechanism **106**. As a result, the softened adhesive G is hardened such that the target substrate W and the glass substrate S are bonded to each other.

After the first chamber portion **511** moves up by movement mechanisms (not illustrated), the superposed substrate T thus formed is carried out from the bonding unit **90** by the transfer unit **80**, and transferred to the cassette Ct in the above-mentioned order.

<5. Temporary Bonding Processing>

In the bonding system **1** according to the present exemplary embodiment, a glass substrate S is used as a support substrate, and an electrostatic chuck is used as a second holding unit **201** that holds the glass substrate S. Further, in the bonding system **1** according to the present exemplary embodiment, the temperature increasing processing in which the temperature in the chamber **501** is increased from the first temperature to the second temperature, is performed as described above.

In order to electrostatically adsorb the glass substrate S, a high voltage is applied to the second holding unit **201**. Further, the second temperature is a temperature higher than the glass transition temperature of the glass substrate S. Accordingly, if the glass substrate is heated to the second temperature in a state of being electrostatically adsorbed by using the second holding unit **201** as an electrostatic chuck, sodium may be precipitated as sodium ions in the glass substrate S migrate to the contact surface with the second holding unit **201**.

If sodium is precipitated, problems such as surface deterioration of the second holding unit **201** or deformation of the glass substrate S may occur. It may be considered that the electrostatic adsorption of the glass substrate S by the second holding unit **201** is released in the temperature increasing processing. However, misalignment of the glass substrate S may occur in such a case.

Therefore, in the bonding system **1** according to the present exemplary embodiment, the target substrate W and the glass substrate S are held by the first holding unit **101** and the second holding unit **201**, respectively, and then, a temporary bonding processing is performed to temporarily bond the target substrate W and the glass substrate S at a temporary pressure and temperature lower than those in the main bonding processing. Then, after the electrostatic adsorption by the second holding unit **201** is released, the temperature increasing processing is performed.

The temporary bonding processing will be described in detail with reference to FIG. **12**. FIG. **12** is a timing chart illustrating a processing sequence of the bonding processing according to the present exemplary embodiment.

As illustrated in FIG. **12**, in the bonding unit **90**, after the alignment processing is terminated, the first chamber portion **511** moves down, and the decompression processing is performed. In the decompression processing, the pressure in the chamber **501** is decreased from the atmospheric pressure atm to a predetermined pressure Pc**2**. Particularly, the pressure in the chamber **501** is decreased from the atmospheric pressure atm to a pressure Pc**1**, and then, to the predetermined pressure Pc**2** by changing the intake device **532** (see FIG. **4**) to another intake device having a stronger intake force than that of the intake device **532**.

Thereafter, the temporary bonding processing is performed. In the temporary bonding processing, the target substrate W is brought into contact with the glass substrate S by moving down the first holding unit **101** using the pressing mechanism **106**, and both of the substrate are pressed with a pressing force Pb**1** lower than a pressing force Pb**1** in the main bonding.

At this time, the electrostatic adsorption units **111**, **211** of the first holding unit **101** and the second holding unit **201** are in a state of ON, but the temperature in the chamber **501** is a first temperature T**1** not higher than the glass transition temperature of the glass substrate S. Therefore, there is no concern that sodium may be precipitated from the glass substrate S.

Further, the pressing force Pb**1** in the temporary bonding processing is, for example, the same pressure as the atmospheric pressure. Since the inside of the chamber **501** has been decompressed, the target substrate W and the glass substrate S are in a state of being pressed even at the atmospheric pressure.

After the temporary bonding processing is terminated, the electrostatic adsorption by the electrostatic adsorption units **111**, **211** is released in the bonding unit **90**, and the target substrate W and the glass substrate S start to be heated from the first temperature T**1** to a second temperature T**2** in a state of being pressed with the pressing force Pb**1**. After reaching the second temperature T**2**, in the bonding unit **90**, the main bonding is performed on the target substrate W and the glass substrate S using the pressing mechanism **106** with the predetermined pressing force Pb**2**.

As described above, in the bonding system **1** according to the present exemplary embodiment, since the electrostatic adsorption by the electrostatic adsorption units **111**, **211** is released before starting to heat, there is no concern that sodium may be precipitated in the subsequent temperature increasing processing, bonding processing and temperature decreasing processing. Further, even though the electrostatic adsorption by the electrostatic adsorption units **111**, **211** is released, since the target substrate W and the glass substrate S is temporarily bonded, there is no concern that misalignment of the target substrate W and the glass substrate S may occur.

According to the bonding system **1** of the present exemplary embodiment, it is possible to suppress sodium precipitation from the glass substrate S while suppressing misalignment of the target substrate W and the glass substrate S.

Here, the electrostatic adsorption by the electrostatic adsorption units **111**, **211** was released after the target substrate W and the glass substrate S were temporarily bonded. However, the timing of releasing the electrostatic adsorption may be simultaneous with the temporary bonding processing. That is, the bonding unit **90** may release the electrostatic adsorption by the electrostatic adsorption units **111**, **211** at the timing when the target substrate W and the glass substrate S come into contact with each other in the temporary bonding processing. Accordingly, it is possible to release the electrostatic adsorption in an earlier stage while suppressing misalignment of the target substrate W and the glass substrate S.

Further, here, the heating to the second temperature T**2** starts after the electrostatic adsorption by the electrostatic adsorption units **111**, **211** is released. However, the timing of starting heating to the second temperature T**2** may be simultaneous with or earlier than the release of the electrostatic adsorption. That is, the electrostatic adsorption by the electrostatic adsorption units **111**, **211** may be released at least before exceeding the glass transition temperature of the glass substrate S.

Further, here, the target substrate W and the glass substrate S are electrostatically adsorbed by the electrostatic adsorption units **111**, **211** during the alignment processing and the decompression processing. However, if the target substrate W and the glass substrate S are electrostatically adsorbed under the atmospheric environment and then decompression is performed to a predetermined pressure, discharge may be generated during the decompression (Paschen's law), and thus, the target substrate W and the glass substrate S may be damaged.

Therefore, the bonding unit **90** may adsorb and hold the target substrate W and the glass substrate S using the vacuum adsorption units **112**, **212** in the alignment processing, and then, after the decompression has progressed to some extent in the decompression processing, change the adsorption to the electrostatic adsorption by the electrostatic adsorption units **111**, **211**. As s result, the target substrate W and the glass substrate S may be suppressed from being damaged by discharge.

In the main bonding processing, the state of pressing the target substrate W and the glass substrate S with the predetermined pressing force Pb**2** at the second temperature T**2** is maintained for a predetermined time. Further, in the main bonding processing, the pressure in the chamber **501** is changed from Pc**2** to Pc**3**.

Thereafter, in the bonding unit **90**, the temperature in the chamber **501** is decreased from the second temperature T**2** to the first temperature T**1** using the first cooling mechanism **102** and the second cooling mechanism **202**. At this time, by decreasing the temperature while pressing the target substrate W and the glass substrate S with the predetermined pressing force Pb**2**, the superposed substrate T may be suppressed from being warped. Further, in the temperature decreasing processing, the pressure in the chamber **501** is returned from Pc**3** to the atmospheric pressure atm. Then, the superposed substrate T is carried out from the bonding unit **90**, and a series of bonding processings are terminated.

<6. Fail-Safe Processing>

Descriptions will be made on the processing sequence of a fail-safe processing using the first temperature detection units **301**, **303** and the second temperature detection units **302**, **304** with reference to FIG. **13**. FIG. **13** is a flowchart illustrating a processing sequence of the fail-safe processing. Further, the fail-safe processing as illustrated in FIG. **13** is performed, for example, during the temperature increasing processing and the main bonding processing as described above.

Here, descriptions will be made on a case of detecting warpage of the first cooling mechanism **102** using the first temperature detection unit **303** and the second temperature detection unit **302**. The processing of detecting warpage of the second cooling mechanism **202** using the first temperature detection unit **301** and the second temperature detection units **304** is performed in the same processing sequence as and in parallel with the first cooling mechanism **102** as described below.

As illustrated in FIG. **13**, the control device **5** acquires a detection result of the first temperature detection unit **303**, that is, the temperature of the target substrate W (step S**101**), and acquires a detection result of the second temperature detection unit **302**, that is, the temperature of the outer periphery of the first cooling mechanism **102** (step S**102**). Subsequently, the control device **5** determines whether the temperature difference between the target substrate W and the outer periphery of the first cooling mechanism **102** is more than the threshold (step S**103**).

And, when it is determined that the temperature difference is more than the threshold in the processing (step S**103**, Yes), the control device **5** instructs the bonding unit **90** to stop heating (step S**104**), and terminates the fail-safe processing. As a result, the bonding unit **90** stops the first heating mechanism **117**, the second heating mechanism **217**, the third heating mechanism **103** and the fourth heating mechanism **203**. Meanwhile, when the temperature difference between the target substrate W and the outer periphery of the first cooling mechanism **102** is not more than the threshold (step S**103**, No), the control device **5** repeats, for example, the processings of steps S**101** to step S**103**.

By performing such a fail-safe processing, in the bonding system **1** according to the present exemplary embodiment, even if warpage occurs in the first cooling mechanism **102** and the second cooling mechanism **202**, further warpage may be suppressed from occurring, and thus, the first holding unit **101** and the second holding unit **201** may be prevented from being damaged.

As described above, the bonding apparatus **45** according to the present exemplary embodiment is provided with a first holding unit **101**, a second holding unit **201**, a pressing mechanism **106**, a first cooling mechanism **102**, a second cooling mechanism **202**, a third heating mechanism **103** and a fourth heating mechanism **203**.

The first holding unit **101** is provided with a first heating mechanism **117** and holds a target substrate W that is a first substrate. The second holding unit **201** is disposed facing the first holding unit **101**, is provided with a second heating mechanism **217** and holds a glass substrate S that is a second substrate. The pressing mechanism **106** relatively moves the first holding unit **101** and the second holding unit **201** to contact and press the target substrate W and the glass substrate S. The first cooling mechanism **102** is provided at an opposite side to a holding surface **113** of the first holding unit **101**, and cools the target substrate W through the first holding unit **101**. The second cooling mechanism **202** is provided at an opposite side to a holding surface **213** of the second holding unit **201**, and cools the glass substrate S through the second holding unit **201**. The third heating mechanism **103** is provided at a side of the first cooling mechanism **102** opposite to the side on which the first holding unit **101** is disposed, and heats the first cooling mechanism **102**. The fourth heating mechanism **203** is provided at a side of the second cooling mechanism **202** opposite to the side on which the second holding unit **201** is disposed, and heats the second cooling mechanism **202**.

Therefore, according to the bonding apparatus **45** of the present exemplary embodiment, it is possible to suppress the first holding unit **101** and the second holding unit **201** from being damaged.

Further, the bonding apparatus **45** according to the present exemplary embodiment is provided with a first holding unit **101**, a second holding unit **201**, a pressing mechanism **106**, a first holding mechanism **401** and a second holding mechanism **402**. The holding mechanism **401** and the second holding mechanism **402** elastically hold outer peripheries of the first holding unit **101** and the second holding unit **201**.

Therefore, according to the bonding apparatus **45** of the present exemplary embodiment, it is possible to suppress the first holding unit **101** and the second holding unit **201** from being misaligned.

Further, the bonding method according to the present exemplary embodiment includes a first holding processing, a second holding processing, a temporary bonding processing, a temperature increasing processing and a main bonding processing. In the first holding processing, a target substrate W is held. In the second holding processing, a glass substrate S is held by an electrostatic adsorption. In the temporary bonding processing, after the first holding processing and the second holding processing, the target substrate W and the glass substrate S are temporarily bonded with a pressing force lower than a predetermined pressing force at a temperature lower than a predetermined temperature. In the temperature increasing processing, at the same time as or after the temporary bonding processing, the electrostatic adsorption of the glass substrate S is released and the temperature is increased to a predetermined temperature. In the main bonding processing, after the temperature increasing processing, the target substrate W and the glass substrate S are subjected to main bonding with the predetermined pressing force.

Therefore, according to the bonding method of the present exemplary embodiment, it is possible to suppress sodium precipitation from the glass substrate S.

In the above-mentioned exemplary embodiment, application of the adhesive G and heat treatment are performed on the target substrate W in the application and heat treatment block G**1**, and then, the target substrate W and the glass substrate S are bonded in the bonding processing block G**2**. However, in a case of handling a target substrate W on which an adhesive G is applied in advance, the processing in the application and heat treatment block G**1** may be omitted. Further, in such a case, the bonding system **1** is not necessarily provided with the application and the heat treatment block G**1**.

Further, in the above-mentioned exemplary embodiment, the control device **5** controls the first holding unit **101**, the second holding unit **201**, the pressing mechanism **106** and the like provided in the bonding apparatus **45**. However, the bonding apparatus **45** may be provided with, for example, a control unit configured to control the first holding unit **101**, the second holding unit **201**, and the pressing mechanism **106**.

Further, in the above-mentioned exemplary embodiment, a case where a glass substrate is used as a support substrate is described. However, for example, a silicon wafer may be used as a support substrate instead of the glass substrate.

From the foregoing, it will be appreciated that various embodiments of the present disclosure have been described herein for purposes of illustration, and that various modifications may be made without departing from the scope and spirit of the present disclosure. Accordingly, the various embodiments disclosed herein are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

What is claimed is:

1. A bonding apparatus comprising:

a first holding unit configured to hold a first substrate;

a second holding unit disposed facing the first holding unit and configured to hold a second substrate;

a pressing mechanism configured to relatively move the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate; and

a holding mechanism configured to elastically hold an outer periphery of the first holding unit and the second holding unit,

wherein the holding mechanism is provided with a vertically biasing member configured to bias the first holding unit or the second holding unit vertically with respect to a holding surface of the first holding unit or the second holding unit, and holds the first holding unit or the second holding unit elastically by using the vertically biasing member,

a step dented in the holding surface is provided in the outer periphery of the first holding unit and the second unit, and

the holding mechanism is further provide with a claw portion abutting the step and biased vertically by the vertically biasing member.

2. The bonding apparatus of claim **1**, wherein the claw portion is provided with a coil spring on a surface facing the step.

3. The bonding apparatus of claim **1**, wherein the holding mechanism is provided with a horizontally biasing member configured to bias the first holding unit or the second holding unit horizontally with respect to the holding surface of the first holding unit or the second holding unit, and holds the first holding unit or the second holding unit elastically by using the horizontally biasing member.

4. The bonding apparatus of claim **1**, wherein a plurality of the holding mechanisms are installed with respect to the outer periphery of the first holding unit and the second holding unit.

5. The bonding apparatus of claim **1**, wherein the first holding unit and the second holding unit are laminated with a predetermined room in a horizontal direction with respect to a predetermined member.

6. The bonding apparatus of claim **1**, wherein each of the first holding unit and the second holding unit is provided with heating mechanisms configure to heat the first substrate or the second substrate, respectively.

7. The bonding apparatus of claim **1**, further comprising:

a chamber configured to accommodate the first holding unit and the second holding unit; and

a decompression mechanism configured to decompress the chamber.

8. The bonding apparatus of claim **1**, wherein each of the first holding unit and the second holding unit is provided with an electrostatic adsorption unit configured to electrostatically adsorb the first substrate or the second substrate, respectively.

9. A bonding system comprising:

a carry-in/out station configured to place a first substrate and a second substrate;

a substrate transfer apparatus configured to transfer the first substrate and the second substrate placed in the carry-in/out station; and

a bonding station provided with a bonding apparatus configured to bond the first substrate and the second substrate transferred by the substrate transfer apparatus,

wherein the bonding apparatus includes:

a first holding unit configured to hold the first substrate;

a second holding unit disposed facing the first holding unit and configured to hold the second substrate;

a pressing mechanism configured to relatively move the first holding unit and the second holding unit in order to contact and press the first substrate and the second substrate; and

a holding mechanism configured to hold the outer periphery of the first holding unit and the second holding unit,

the holding mechanism is provided with a vertically biasing member configured to bias the first holding unit or the second holding unit vertically with respect to a holding surface of the first holding unit or the second holding unit, and holds the first holding unit or the second holding unit elastically by using the vertically biasing member,

a step dented in the holding surface is provided in the outer periphery of the first holding unit and the second unit, and

the holding mechanism is further provided with a claw portion abutting the step and biased vertically by the vertically biasing member.

* * * * *